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GENERAL

2629 **Acceptance trials of computer systems for government use.** R. O. Bennett and J. B. Stringer, *Computer J.*, **4,** Oct. 1961, 185-192, disc. 193-196. This paper is concerned with the work of the A.D.P. Technical Support Unit with regard to acceptance tests for digital computers for use in government offices. The general principles are discussed on which the tests are designed to fulfil three main functions: (1) to ensure that the equipment is complete; (2) to ensure that the equipment is capable of reliably fulfilling the task for which it is being supplied; (3) to provide an opportunity for the operating manager to establish confidence in the system. The standard conditions under which the trials are held are described and experience with acceptance testing is outlined. Finally, possible improvements in the standard conditions suggested by this experience are indicated.

2630 **Computer Kundendienst für Büroarbeiten.** (Commercial computer service for office work.) D. Broido, *Elektronische Datenverarbeitung*, No. 5, 1961, 209-212. (In German.) This paper is concerned with the computing service of Leo Computers Limited. Experience in the establishment and practical work of the service is described, and kind and size of problems, costs and maintenance are discussed. Some factors which influence the efficiency of the service are mentioned.

2631 **Computing machines for teaching and research.** L. Fox, *Computer J.*, **4,** Oct. 1961, 212-216. This paper briefly discusses the use of computers for research in universities, but is mainly concerned with the teaching in universities and technical colleges of the use of computers (programming, numerical analysis, etc.).

2632 **The Ferranti Pegasus 1 computer installation of the Steel Company of Wales Limited.** G. W. Thomas, *Elektronische Datenverarbeitung*, No. 5, 1961, 220-224. An account is given of the experiences of the Operational Research Department of the Steel Company of Wales Limited in installing and operating a Ferranti Pegasus 1. 6 refs.

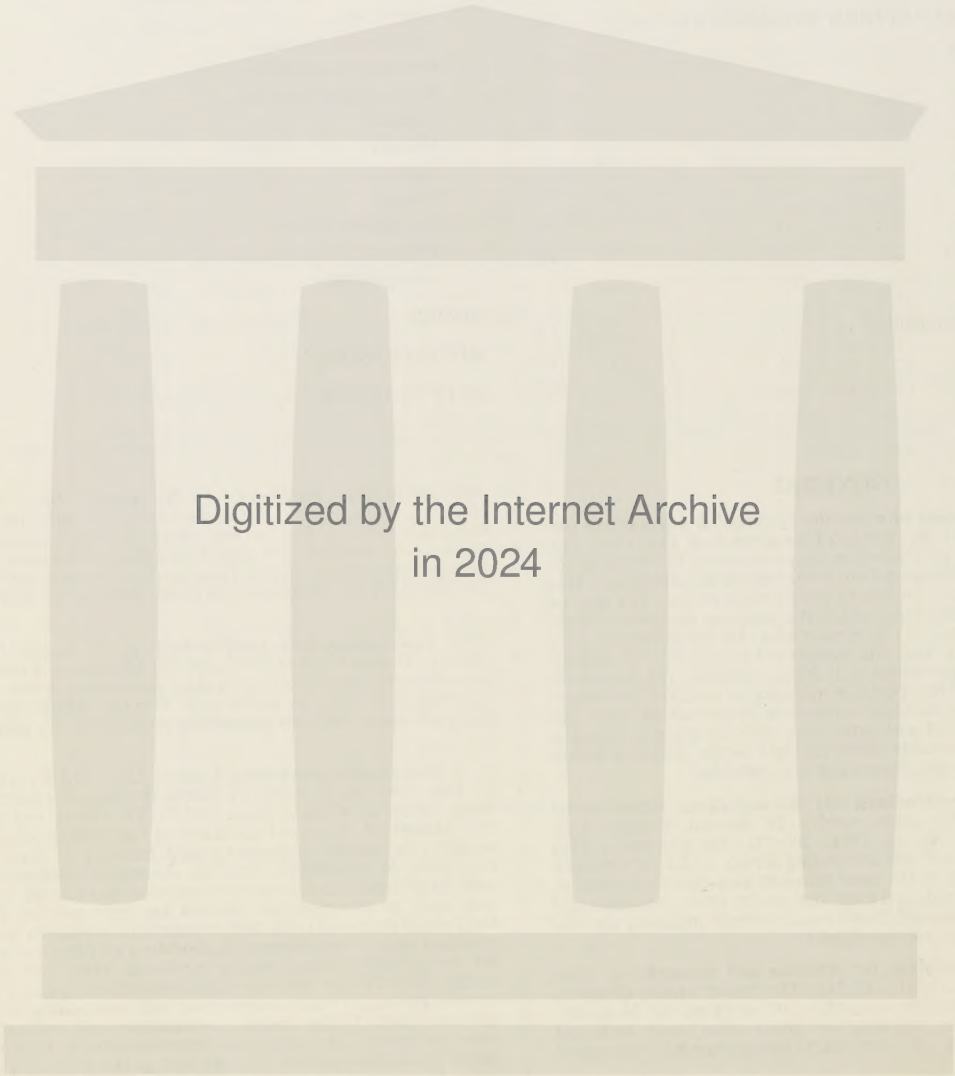
2633 **Random access versus serial access.** J. Crownshaw; F. Land; J. Martin; G. Ziman, *Auto. Data Processing*, **3,** Oct. 1961, 20-24, 56-57. The four authors discuss generally, in separate contributions, as to whether random access or serial storage of data is preferable. Crownshaw and Martin put the case for random access and the other two authors the case for serial processing, but each of the four admits, in effect, that there are applications for which each type of storage is the more suitable.

2634 **Simulating hardware.** J. A. Joyce, *Data Processing (Detroit)*, **3,** Oct. 1961, 37-39. An account of how the Adjutant General's School, U.S. Army, gives general training in computers, *without* using an actual computer, by means of blackboards ruled-off in squares representing memory, registers, etc., and in which the instructor can chalk instructions and data.

2635 **Top management participation.** R. V. Lewis, *Data Processing (Detroit)*, **3,** Oct. 1961, 34-35. The author's thesis is that for successful installation of a data processing system top management must take an active role. Ways in which management can participate in a data processing programme are suggested.

2636 **Information processing.** Lincoln Lab., M.I.T., *AD-260633*, 15 June 1961, 64 p., $6.60. A quarterly progress report (March-May 1961) of Lincoln Lab., M.I.T. The FX-1 test computer was assembled. A partial checkout of the central computer was made. The machine's magnetic film memory is being checked out, prior to installation. Barring unforeseen difficulties, FX-1, with its planned 0.2-microseconds read-write memory cycle time, will soon be in operation. Within the past quarter TX-2 was used on Projects MIDAS and Mercury, on a pattern recognition problem and by the Research Laboratory of Electronics (M.I.T.) on an adaptive programming problem. Work on sequential coding (SECO) for two-way communications systems continue in two phases: (1) the construction with evaluation of a single decoder, and (2) the design, construction and evaluation of a two-way system. A number of improvements in both the automatic speech recognition activity and in the programs for computer interpretations of natural English text (BASEBALL) were observed. A new version of the degarbler, a computer program for automatically correcting errors in English text, was developed which promises to correct substantially more errors than earlier versions. 21 refs.

2637 **Man-machine system performance criteria.** A. W. Story, Operational Applications Office, Air Force Electronics Systems Div., *AD-260528*, May 1961, 61 p., $6.60. Four categories of criteria are developed for the evaluation of man-machine system performance. The applicability of these criteria during system design, building, and testing is discussed. Some illustrative evaluations of man-machine systems are surveyed. Problems that accrue through the use of simulative features in the assessment of system performance are considered. 23 refs.



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2638 **Part I. High-speed computer program; Part II. Circuit research program; Part III. Mahematical methods; Part IV. Data reduction methods; Part V. ILLIAC use and operation; Part VI. IBM 650 use and operation; Part VII. General laboratory information**. Digital Computer Laboratory, University of Illinois, *TID-13315,* March 1961, 55 p., $5.60.

2639 **Plans for man-computer communications research using the Reliability Test Assembly Computer and the advanced display console as research tools.** Operational Applications Office, Air Force Electronic Systems Div., *AD-260505,* June 1961, 11 p., $1.60. The advanced display console and RTA Computer developed under SAGE II contracts will be modified for use in man-machine communications experiments. Man-machine communication procedure will be studied in five aspects: (1) preparation of data to make up visual messages; (2) presentation of the messages; (3) retrieval of data not already displayed; (4) choice behaviour of the man; and (5) processing of the man's output. Present scheduling indicates full availability of the equipment for communications experiments by 1 February 1962.

See also:—
Applications, Simulation: Ref. 2868*a*.

DESIGN

2640 **Addressing a double triangular matrix.** M. P. Marcus, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 40. In a matrix having bistable elements arranged in a double triangular configuration, two addresses are associated with a selected pair of drivers. One address is indicated when the drivers drive in the same relative direction and another address when they drive in relatively opposite directions. An arrangement is described for controlling the directions of drive of the drivers.

2641 **Application of computers to circuit design for UNIVAC LARC.** G. Kaskey, N. S. Prywes and H. Lukoff, *Proc. Western Joint Computer Conference,* 1961, 185-205. In this paper several applications of computers in computer circuit design are reported and demonstrated by case histories for UNIVAC LARC. In the first part of the paper, a general description of the problems and solutions is given, the problem areas being divided into three categories: evaluation of components and life tests; circuit design; and reduction of noise and delay in backboard wiring. The second part of the paper gives a detailed description of statistical techniques used in the circuit design of a particular transistor flip-flop. 10 refs.

2642 **Design of practical self-repairing computer systems.** M. V. Wilkes, *Control,* **4,** Oct. 1961, 86-88. The author suggests that a self-repairing computer system might be achieved by having the correct working of the entire computer verified at frequent intervals by the performance of a test program, or by the successful completion of checks incorporated in the operational program. When faulty operation is detected, the fault is cleared by the elimination from the computer of the faulty unit. Practical problems, such as that of designing a switching system for interchanging units, are discussed. 1 ref.

2643 **Error checking and comparing.** F. Gerrand and G. Thomas, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 22-23. Description of circuitry which compares two words, each having associated with it a parity bit.

2644 **Factors affecting the choice of memory.** C. F. King, *Proc. Western Joint Computer Conference,* 1961, 405-409. This paper discusses the determination of hierarchical levels of data storage from a computer system's requirements. A sample set of levels is derived for a hypothetical computer system. General comments are made on the choice between magnetic cores and magnetic drums. It is concluded that as computer designers become more sophisticated there will be a greater tendency to multi-level memories and a wide application for the many techniques for storage of information. 1 ref.

2645 **A generalized tree circuit**. H. A. Curtis, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 484-496. The object of this paper is to expand the practical and theoretical scope of the tree circuit by the formulation of a generalised tree circuit, which in actuality is a set of circuits having basic tree circuit characteristics. 3 refs.

2646 **High speed optical computers and quantum transition memory devices.** L. C. Clapp, *Proc. Western Joint Computer Conference,* 1961, 475-489. This paper attempts to answer the question: 'Is there a method of transmitting information from one point to another at a rate much greater than 10^6 pulses per second, without generating interference on neighbouring information channels?' by considering the use of light waves for the propagation of signals. After brief consideration of glass fibres for interconnection of optical computer elements and of decision elements employing polarisation techniques, the main part of the paper discusses optical storage elements. The memory devices which are proposed are based on the fact that electrons can make transitions from one quantum mechanical level to another in the order of 10^{-8} or 10^{-9} seconds at optical frequencies. Ground state and certain excited energy levels of an atom, for example, would be used as storage positions with the switching action between logical conditions being optically induced transitions from one energy level to the next. Gaseous, solid state and maser models of such devices are discussed. 11 refs.

2647 **Interconnection techniques for semiconductor networks.** J. S. Kilby, *Proc. Western Joint Computer Conference,* 1961, 87-94. This paper briefly discusses some of the factors which have to be considered in equipment design using miniaturised semiconductor networks and describes a technique which might be used for the interconnection of semiconductor circuit packages.

2648 **Micro-system computer techniques.** E. Luedicke and A. H. Medwin, *Proc. Western Joint Computer Conference,* 1961, 95-109. After briefly describing some of the problems encountered in the development of the Project LIGHTNING, 1,000 Mc/s, tunnel diode computer, some of the techniques developed for the computer are described. Among the items discussed are ceramic circuit wafers with fired-on metallised circuitry and ground plane, vacuum deposited rod resistors, a grooved channel wiring assembly which holds the wafers, a new approach to a flexible transmission line, and a tunnel diode memory plane.

2649 **A new approach to the functional design of a digital computer.** R. S. Barton, *Proc. Western Joint Computer Conference,* 1961, 393-396. The present methods of determining the functional design of digital computers are critically reviewed and a new approach proposed. This is illustrated by explaining, in abstracted form, part of the control organisation of a new machine (Burroughs 5000 Information Processing System) based, in part, on the ALGOL 60 language. The concepts of expression and procedure lead directly to use of a Polish string program. A new arrangement of control registers results, which provides for automatic allocation of temporary storage within expressions and procedures, and a generalised subroutine linkage. 4 refs.

2650 **A new type of computer for problems in propositional logic, with greatly reduced scanning procedures.** C. Cherry and P. K. T. Vaswani, *Information & Control,* **4,** Sept. 1961, 155-168. A simple scanning-type binary logical computer starts by assigning the truth-value 0 to all the variables (propositions) and systematically executes a binary count until the truth value 1 is assigned to all variables. With n variables a scan of 2^n steps is then needed. At each step, all the logical constraints usually are tested simultaneously and only when all are satisfied is a solution to the problem obtained. This paper describes a principle and a machine which give a greatly compressed procedure; they are such that the constraints are examined individually, not simultaneously; if one or more is unsatisfied, a simple criterion is acted upon which greatly reduces the total number of steps required to find the first solution or any number of solutions. A further criterion is established when the last solution has been found, and the machine is stopped. The experimental machine described is relay-operated and is capable of solving problems involving 16 logical variables and not more than 100 logical connectives, but it is considered that the procedure may be of value to scanning-type logical computers for working with large numbers of variables. 5 refs.

2651 **Non-coincident selection of designated locations using thin films.** G. E. Keefe, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 34-35. Description of how coincident selection is achieved by sequential current techniques in a memory in which a continuous strip of thin magnetic film is used as a basic binary storage cell.

2652 **A note on realization of decision networks using summation elements.** P. M. Lewis, *Information & Control,* **4,** Sept. 1961, 282-290. Engineering considerations may place limitations on the size of decision making systems and on the resources of the system designer so that some type of approximation of high order probability distributions is necessary. One type of approximation that has been studied involves measuring and storing several of the lower order component distributions and using these to approximate the high order distribution, using the criterion of maximum entropy. This note considers the related realisation problem for binary distributions. By a realisation of such an approximation is meant a physical network with the following properties: (1) its inputs are the variables on which the decision is to be based; (2) stored within it are the lower order component distributions on which the approximation is to be based; (3) its outputs are approximations to the high order distributions. The realisation problem for maximum entropy approximations is particularly simple because of their functional form. Maximum entropy distributions are always products of functions of the variables in the given component distributions. Therefore, the logarithms of these distributions are sums of functions of these same variables and hence can be easily realised. It is shown that networks consisting of diodes in the form of AND gates and resistors in the form of summation elements can realise any probability approximation satisfying the maximum entropy criterion. 5 refs.

2653 **Parallelism in computer organization random number generation in the Fixed-Plus-Variable Computer System.** M. Aoki, G. Estrin and T. Tang, *Proc. Western Joint Computer Conference,* 1961, 157-172. This paper would appear to be substantially the same as the report *AD-258992* (*C.A.*, **5,** Nov. 1961, Ref. 2396).

2654 **Some methods for simplifying switching circuits using "don't care" conditions.** J. T. Chu, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 497-512. Several methods for simplifying switching circuits using "don't care" conditions are suggested. One of the methods uses the following procedure: Let the given circuit be represented by the truth function F. Let the given "don't care" conditions be denoted by $D=0$. (For example, if $x_1=1$ and $x_2=0$ represent the combination of input signals which never takes place, then $D=x_1x_2$.) Generate all the irredundant disjunctive and conjunctive forms which are equivalent to F whenever $D=0$. From these forms, the simplest ones may then be chosen according to a given measure of simplicity. They correspond to the simplest two-level AND/OR or OR/AND switching circuits which, under the "don't care" conditions, perform the same function as the given circuit. Several methods for generating the equivalent irredundant forms are suggested. Two other simplification methods are also given. 14 refs.

2655 **A survey of microsystem electronics.** P. B. Myers, *Proc. Western Joint Computer Conference,* 1961, 63-74. The history of microsystem electronics is briefly traced through the successive stages of: miniaturisation; subminiaturisation; microminiaturisation, thin-film integrated circuits; semiconductor integrated circuits; and morphological integrated circuits. An integrated circuit is defined as the combination, on or within a single chunk of material, of multiple electrical elements to perform a desired circuit or systems function. Improved reliability, decreased size and weight, decreased power consumption, and lower cost are discussed as motives for the development of integrated circuitry. Fabrication techniques, interconnection and accessibility are identified as major problems. Numerous techniques for fabrication of integrated circuitry are classified and briefly described.

2656 **5-symbol 8-state and 5-symbol 6-state universal Turing machines.** S. Watanabe, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 476-483. The author suggests that it is of interest to design a universal Turing machine smaller than any ever previously published in the literature. The product of the number of states and the number of symbols may be taken as a measure of size of a universal Turing machine. This paper presents one machine with a product of 40—5 symbols and 8 states—and one with a product of 30—5 symbols and 6 states—provided that symbols can be printed on the infinitely many squares of the input tape. 6 refs.

2657 **Testing of micrologic elements.** R. H. Norman and R. C. Anderson, *Proc. Western Joint Computer Conference,* 1961, 75-86. The acceptance tests of integrated logic function elements require a departure from the notion that the parameters of the individual components of a circuit must be known. A test programme based on external characteristics only is made necessary by the complexity of the circuit and it is asserted in this paper that it is possible to test a completed integrated circuit by examining only its external characteristics in such a way that it can be accurately determined that its present operation is satisfactory and also that continued operation over wide environmental conditions can be expected. The assertion is supported by a description in some detail of a test programme, based on this assertion, for a particular type of integrated circuit—the micrologic element. (Each micrologic element consists of one to five DCTL NOR gates; the circuit components—resistors and planar transistors—are diffused into a single slab of silicon and metal intraconnections are deposited on top of the slab.) 4 refs.

2658 **Trends in design of large computer systems.** C. W. Adams, *Proc. Western Joint Computer Conference,* 1961, 361-364. In this paper, new developments in computer design are reported (using specific systems as illustrations) and trends are analysed; first with regard to physical devices with emphasis on fixed and high speed storage systems; then with regard to logical techniques including various logical organisation schemes, stored logic, concurrent autonomous operation and new approaches to modularity in design.

2659 **Annotated bibliography on the minimization of Boolean formulas and switching circuits.** Parke Mathematical Labs., Inc., *AD-260552,* Dec. 1960, 76 p., $7.60. More than two hundred titles are presented of papers and several books which deal with the problems encountered in the minimisation of Boolean formulae and switching networks, or with mathematical results that have been directly useful in the study of such problems. Wherever possible a short abstract is given. 227 refs.

2660 **Fundamental investigation of digital computer storage and access techniques.** S. W. Miller, Stanford Research Inst., *AD-260117,* May 1961, 90 p., $8.10. The artifice of a conceptual model of a storage unit is used in order to classify the various kinds of storage units according to their terminal characteristics. The important terminal characteristics are the storage capacity, speed and order of access, the operating mode, and the permanence of the stored data. This model is dissected into four fundamental parts: an aggregate of storage registers, access equipment for selection and excitation of the desired register, the sensing equipment for determining the data stored in the register, and the organisational scheme used for their interconnection. The various techniques for achieving these fundamental operations, either in use or being developed, are outlined and discussed. The relation between the use of particular techniques in a storage unit and the position of that storage unit on the capacity vs speed graph is shown with some predictions for improvements. 112 refs.

2661 **An improvement in the reliability of analog circuitry through the application of redundancy.** A. A. Sorensen, Space Technology Labs., Inc., *AD-260459,* May 1961, 39 p., $4.60. The results obtained by the application of redundancy to various types of analogue circuitry are summarised. Comparisons are made between several possible techniques after the application of both passive and active switching redundancy are applied. Formulae are derived enabling the designer to find out the actual reliability improvements that may be expected from redundancy.

2662 **Improving reliability of digital systems by redundancy and adaption.** W. H. Pierce, Stanford University, *AD-261113,* 17 July 1961, 121 p., $10.50. Redundancy and adaption will have engineering value in improving the reliability of digital systems if they can provide reliability not otherwise attainable, or if they can provide reliability more economically than other methods. The specific methods of using linearly separable decision elements proposed in this report show promise of value by both of the above criteria. Decision elements provide a means of overcoming the non-zero failure probability which will always be associated with every component of a digital system. They also permit systems with various amounts of component reliability to meet the same system reliability specifications by using appropriate amounts of redundancy and adaption. A given system reliability may be attained most economically by a redundancy greater than one. Examples calculated for system yield and lifetime show that the factor of increase in system yield or lifetime can be considerably more than the factor by which the redundancy is increased. The examples also indicate the possibility that the factor of increase in reliability of adaptive circuits over unadaptive ones could exceed the cost factor of the adaptive circuits. 20 refs.

2663 **Magnetic core access switches.** J. L. Haynes and R. C. Minnick, Stanford Research Inst., *AD-260118,* May 1961, 264 p., $17.00. A number of the more commonly known magnetic core access switches are combined in a single analytical model. In addition to yielding as special cases the known access switches on which it is based, this model produces many apparently new switches. Relationships among the various parameters in this model are developed in such a way that the designer may choose the number of drivers, the load-sharing factor, the number of turns of wire per switch core and the magnitude of the maximum disturbing magnetomotive force within certain limits. As further aids to the designer, a number of tables are included and algorithms are given which may be used to match the switch properties closely to the design requirements. Several methods are developed for economising on the number of drivers used in switches, and certain special access switches are treated. The current knowledge is reviewed on a fairly recent and important class of access switches, known as load-sharing zero-noise switches. These switches are compared with one another, and a fundamental theorem is proved that such switches can have no more outputs than inputs. Several new classes of load-sharing zero-noise switches are developed and analysed; in particular, switches are developed which for a given number of outputs allow more flexibility in the choice of the load-sharing factor than formerly was the case. 52 refs.

2664 **Project Lightning.** RCA Industrial Electronic Products, *AD-260392,* 30 Nov. 1960, 257 p., $16.50. Interim research report No. 8A on High-Speed Data Processor System Research has the following contents list: Millimicrosecond logic circuits—clock powered circuits, baseband circuits; Memories; Fabrication; Memory test machine design; System studies; Instrumentation. See also Refs. 2665 and 2666.

2665 **Project Lightning.** RCA Industrial Electronic Products, *AD-260463,* 1 Dec. 1960, 116 p., $9.60. A supplemental report to interim research report No. 8A (see Ref. 2664). The main topics, covering areas in circuit and memory development, are: Exploratory research; Device research and production; Certain additions not completed in time for inclusion in the main report.

2666 **Project Lightning.** P. Warburton, RCA Industrial Electronic Products, *AD-260471,* 30 Nov. 1960, 24 p., $2.60. Appendix 3 to interim research report No. 8A (see Ref. 2664) has the following contents list: The premise of Project Lightning system studies; Input-output computers; A small 48-bit computer; System design of a large 48-bit computer.

2667 **The selection problem for minimal-state sequential circuits.** W. H. Davidson, Stanford University, *AD-260782,* 20 July 1961, 22 p., $2.60. A technique is discussed that will select from the set of minimal-state circuits those which will have the lowest expected logic cost. The relation between information content and the expected cost of the logic is clearly demonstrated for the cases discussed. This indicates that if circuits can be designed that have small information contents, they will also have inexpensive associated logic. It may be possible to find design procedures that will generate circuits with small information contents and thus with low-cost logic. Also, it seems reasonable to expect that a relation should exist between an appropriately defined information content for the circuit's input-output sequences and its information content.

2668 **A state assignment technique for synchronous sequential networks.** W. H. Davidow, Stanford University, *AD-260781,* 20 July 1961, 34 p., $3.60. The way in which states are assigned in synchronous sequential networks greatly influences the cost of the associated logic. The state assignment problem is discussed, and an assignment technique is described that is very effective for non-cyclic circuits whose logical equations contain less than five variables. The principal advantages of this technique are that it is simple and that it can be applied effectively to find low-cost assignments for almost all synchronous sequential networks. A new approach to the assignment problem is introduced. Statistical predictions rather than absolute minimality are used as a criterion for evaluating the quality of an assignment. An assignment is considered to be good if the probability of finding a better assignment is small.

2669 **Arithmetic unit.** Philips Electrical Industries Ltd., *B.P. 879159,* 4 Oct. 1961. This patent discloses an improvement to the arithmetic unit described in *B.P. 876988* (*C.A.,* **5,** Nov. 1961, Ref. 2399), whereby the production of end carry is speeded up.

2670 **Counting tube circuit.** Burroughs Corp., *U.S.P. 2999183,* 5 Sept. 1961. This patent relates to a magnetron-type multiposition electron beam tube which operates with crossed electric and magnetic fields, and describes an improved circuit for stopping and locking such a tube in any position.

2671 **Digital computer control unit.** Burroughs Corp., *U.S.P. 3001708,* 26 Sept. 1961. This patent is concerned with the provision of simplified control logic for a digital computer. An increase in speed is obtained by employing timing based on a selectable number of digit pulses rather than a fixed number.

2672 **Transformer coupling of logical circuits.** Int. Business Machines Corp., *U.S.P. 3002107,* 26 Sept. 1961. This patent is concerned with the transformer coupling of transistor switching circuits.

See also:—
General: Refs. 2636 and 2638.
Mathematics: Ref. 2708.
Elements: Ref. 2753.
Applications, Aero- and Astronautical: Ref. 2816.

LEARNING AND PATTERN RECOGNITION

2673 Analysis of perceptrons. H. D. Block, *Proc. Western Joint Computer Conference,* 1961, 281-289. This paper gives a brief introduction to perceptrons and describes some of the results of mathematical analysis of simple perceptrons and of four layer series-coupled perceptrons. 7 refs.

2674 **A basis for a mathematical theory of computation, preliminary report.** J. McCarthy, *Proc. Western Joint Computer Conference,* 1961, 225-238. This paper presents an attempt to create a basis for a mathematical theory of computation. Programs that learn to modify their own behaviour require a way of representing algorithms so that interesting properties and interesting transformations of algorithms are simply represented. Theories of computability have been based on Turing machines, recursive functions of integers and computer programs. Each of these has artificialities which make it difficult to manipulate algorithms or to prove things about them. The paper presents a formalism based on conditional forms and recursive functions whereby the functions computable in terms of certain base functions can be simply expressed. Also described are some of the formal properties of conditional forms and a method called recursion induction for proving facts about algorithms. 11 refs.

2675 **Descriptive languages and problem solving.** M. Minsky, *Proc. Western Joint Computer Conference,* 1961, 215-218. The author suggests that the machine solution of increasingly complex problems will require the use of non-trivial formal and descriptive language systems, and indicates in this paper some of the considerations that seem to point towards the incorporation of complex linguistic processes into the next generation of heuristic programs. Internal languages will be required for the description and abstraction of the outcomes of experiments. As more complex problems are attempted there will have to be less trial and error and more systematic analysis of the results of each trial. Learning on the basis of experience will require a phase of refinement in which the machine will attempt, by analysis and inductive inference, to get as much as possible from each experiment. 2 refs.

2676 **Design of sequential machines from their regular expressions.** G. Ott and N. H. Feinstein, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 585-600. Procedures are given to convert any regular expression into a state diagram description and neural net realisation of a machine that recognises the regular set of sequences described by the given expression. It is established that any regular expression with a finite number of connectives describes a regular set of sequences that can be recognised by a finite state machine. All the procedures given are guaranteed to terminate in a finite number of steps, and a generalised computer program can be written to handle the entire conversion. 7 refs.

2677 **An experimental program for the selection of "disjunctive hypotheses".** M. Kochen, *Proc. Western Joint Computer Conference,* 1961, 571-578. This paper presents an algorithm for finding the characterisation of a class of objects on the basis of a randomly ordered sequence of labeled individual objects—some members of the class, some not. The class is characterised as a disjunction of terms, each term being a conjunction of attributes, for example, 'all red, round objects or all square, small objects'. The evaluation of this algorithm by testing it in the form of an IBM 709 program is discussed. 5 refs.

2678 **Least upper bounds on minimal terminal state experiments for two classes of sequential machines.** T. N. Hibbard, *J. Assn. Computing Mchy.*, **8,** Oct. 1961, 601-612. This paper considers the problem of determining the state of a sequential machine. Theorems are proved giving the least upper bounds on minimal terminal state experiments for the class of complete sequential machines and the class of input-independent machines. 6 refs.

2679 **Modeling human mental processes.** H. A. Simon, *Proc. Western Joint Computer Conference,* 1961, 111-119. This paper outlines the development over the past decade of the use of computers to construct and test non-numerical information processing explanations for human thinking and learning. Computer simulations of human thinking are first broadly classified according to their closeness to, or remoteness from, underlying physiological processes. Approaches to non-numerical computation are then considered and it is pointed out that the computer can be used to simulate verbal behaviour without first encoding it or forcing it into mathematical form. Information processing theories of thinking and their relation to information processing languages for computers are discussed. Finally, various heuristic problem solving programs and recent advances in the simulation of thinking are surveyed. 32 refs.

2680 **A note on the formation of concept and of association by information-theoretical correlation analysis.** S. Watanabe, *Information & Control,* **4,** Sept. 1961, 291-296. This note aims to point out that the method of information-theoretical correlation analysis provides a powerful tool in producing mechanisable models of a certain type of cognitive and recognitive processes, such as concept formation, formation of association, pattern recognition, indexing, taxonomical and other classification, identification of 'clusters', medical diagnosis, etc. It is an advantage of the method that all kinds of correlation, including two-object relations such as similarity and dissimilarity as well as characteristically more-than-two-object relations such as 'exclusion-of-the-third', can all be added on an equal footing to form the total sum of correlation, which is a constant and characteristic of a given set of objects. 3 refs.

2681 **A note on recognition of hand-printed characters.** H. W. Tuffill, *Information & Control,* **4,** Sept. 1961, 197. Note referring to the paper, 'A note on human recognition of hand-printed characters', U. Neisser and P. Weene, *ibid,* **3,** June 1960, 191-196 (*C.A.*, **4,** Sept. 1960, Ref. 1703) which reported the results of investigations into the accuracy of human recognition of hand-printed characters. The note briefly discusses the disagreement between the error rate (4%) reported in the earlier paper and the error rate (15%) found by the author in similar tests.

2682 **A pattern recognition program that generates, evaluates, and adjusts its own operators.** L. Uhr and C. Vossler, *Proc. Western Joint Computer Conference,* 1961, 555-569. This paper describes an attempt to make use of machine learning or self-organising process in the design of a pattern recognition program. The program (written for the IBM 709) starts not only without any knowledge of specific patterns to be input, but also without any operators for processing inputs. Operators are generated and refined by the program itself as a function of the problem space and of its own successes and failures in dealing with the problem space. Not only does the program learn information about different patterns, it also learns or constructs, in part at least, a secondary code appropriate for the analysis of the particular set of patterns input to it. 25 refs.

2683 **Programming a model of human concept formulation.** E. B. Hunt and C. I. Hovland, *Proc. Western Joint Computer Conference,* 1961, 145-155. This paper is concerned with a model of human information processing during concept formation which has been constructed using a list processing program. The program's input consists of descriptions of objects in terms of dimensions and values. The universe of objects is divided into two or more sets. The program attempts to form a decision rule, based upon the descriptions of the objects, which can be used to assign any previously presented or new object to its correct set. A general description is given of the program, written for the IBM 709/7090 originally in Information Processing Language V and now being converted to LISP. Simulations of a number of psychological experiments in concept learning are outlined and compared with the data obtained from human subjects. 21 refs.

2684 **A self organizing recognition system.** J. R. Singer, *Proc. Western Joint Computer Conference,* 1961, 545-554. This paper gives a more detailed and formal description of the design of a system for recognition of patterns or objects with provision for size and rotation invariance which has been described by the author elsewhere (see *C.A.*, **5,** Nov. 1961, Ref. 2422). The system is composed of an electronic shutter, a photoreceptor matrix (the retina), a centering system, a pulse timer and a digital computer with a specific program. When the machine is in the learning mode, images appearing on the retina will be centered and transformed (with size invariance) to a canonical matrix which in turn may be reduced to a canonical word stored in the computer memory. After a sizable memory is obtained the machine may be put into the read mode. Each incoming image is tested for a certain degree of matching with previously stored patterns. 5 refs.

2685 **Simulation of behavior in the binary choice experiment.** J. Feldman, *Proc. Western Joint Computer Conference,* 1961, 133-144. This paper is concerned with the use of a digital computer to simulate the behaviour of individual human subjects in a classical psychological experiment where the subject is asked to predict a series of binary events. In this binary choice experiment, the subject is asked to predict which of two events will occur in each of a series of trials and is told, after each prediction, which event actually occurred. After a brief description of the binary choice experiment as used in the research reported (the subject was asked to give reasons for each prediction) and of the basic model for formulating the subject's behaviour as a computer program, the model for a particular subject is described in some detail and a transcript of the results of the experiment for that subject is given. The problem of comparing the behaviour of the model with that of the subject is discussed. The representation of models of human behaviour in the form of computer programs permits the construction and study of more realistic hypothesis-testing models of behaviour in the binary choice experiment rather than the over-simplified conditioning models previously proposed. 8 refs.

2686 **The simulation of verbal learning behavior.** E. A. Feigenbaum, *Proc. Western Joint Computer Conference,* 1961, 121-132. This paper presents an information processing model of elementary human symbolic learning which is realised by a computer program called Elementary Perceiver and Memoriser (EPAM). The program simulates the behaviour of human subjects in experiments involving the rote learning of nonsense syllables (three-letter combinations having no ordinary English meaning). A discrimination net which grows is the basis of EPAM's associative memory. Fundamental information processes include processes for discrimination, discrimination learning, memorisation, association using cues, and response retrieval with cues. Many well-known phenomena of rote learning are found in EPAM's experimental behaviour, including some rather complex forgetting phenomena. EPAM is programmed in Information Processing Language V and has been run on the IBM 704 and IBM 7090. 15 refs.

2687 **Some physiology of automata.** M. L. Babcock, *Proc. Western Joint Computer Conference,* 1961, 291-298. Automata may make use of several methods of information and data reduction before classification or perception of the input stimulus pattern. It is suggested in this paper that it is most expedient to reduce the information as near the source within the automata as is feasible with respect to the over-all system compatibility, and that for this purpose property filtering is applicable. Property filtering is used in the paper as meaning information processing networks arranged in parallel computation channels which extract from the set of input data present certain particular subsets of data which characterise the input data in some manner. This concept is explained and illustrated by describing two practical (the numa-rete and the topological counter) and several theoretical property filters. The results of this work to date indicate that this approach to data reduction and pattern identification may greatly simplify the ultimate construction of adaptive automata, if such property filters are used as functional input units. 2 refs.

2688 **State-identification experiments in finite automata.** A. Gill, *Information & Control,* **4,** Sept. 1961, 132-154. Previous work on the subject of state-identification in finite automata has been limited to devising procedures for some special-purpose identification experiments, and to estimating the lengths of more general experiments. The purpose of this paper is to complement the previous work by presenting procedures for solving general state-identification problems by experiments of various specified characteristics. Classifying identification experiments into preset or adaptive and into simple or multiple, the results contain procedures for identifying the initial state of an automaton by minimal, simple, preset or adaptive experiments, whenever simple, preset experimentation is realisable, and by multiple, preset or adaptive experiments, whenever simple experimentation is not realisable. Procedures are also described for identifying the final state of an automaton by minimal or nonminimal preset or adaptive experiments. Bounds associated with the various procedures are determined, and the applicability of the results to machine-identification problems is discussed. 5 refs.

2689 **Time-analysis of logical processes in man.** U. Neisser, *Proc. Western Joint Computer Conference,* 1961, 579-585. Pattern recognition in man is assumed to be mediated by a hierarchical organisation of specialised systems, each of which abstracts a certain property from its input. Some characteristics of the overall organisation can be inferred from the times that are needed to carry out various information processes. This paper describes the results of some experiments whereby these times can be determined independently of reaction factors by a scanning method. The subject is presented with letter-groups arranged in a column and has to locate a feature, a particular letter for example, which occurs only once. The time to locate the feature is recorded. Preliminary results demonstrate the flexibility of the processing hierarchy in man. They also suggest that parallel processing is used under some conditions, while sequential procedures are dominant in others.

2690 **Turing machines, finite automata and neural nets.** M. Arbib, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 467-475. This paper compares the notions of Turing machine, finite automaton and neural net. A new notation is introduced to replace net diagrams. Equivalence theorems are proved for nets with receptors, and finite automata; and for nets with receptors and effectors, and Turing machines. These theorems are discussed in relation to papers of Copi, Elgot and Wright; Rabin and Scott; and McCulloch and Pitts. It is shown that sets of positive integers 'accepted' by finite automata are recursive, and a strengthened form of a theorem of Kleene is proved. 7 refs.

2691 **What is an intelligent machine?** W. R. Ashby, *Proc. Western Joint Computer Conference,* 1961, 275-280. The main thesis of this paper is that the intelligence of the human brain and of an intelligent machine is the same and that in both cases there is an absolute limitation to intelligence determined by the power to receive and process information. The intelligent processes *par excellence* in both machine and brain are defined as the goal-seeking processes, i.e. those that show high power of appropriate selection. Such appropriate selection (to a degree higher than chance) can be achieved only as a consequence of information received and processed. 3 refs.

2692 **Classification decisions in pattern recognition.** G. S. Sebestyen, M.I.T., *AD-260232, 25* April 1960, 79 p., $8.10. The basic element in the solution of pattern recognition problems is the requirement for the ability to recognise membership in classes. This report considers the automatic establishment of decision criteria for measuring membership in classes that are known only from a finite set of samples. Each sample is represented by a point in a suitably chosen, finite-dimensional vector space in which a class corresponds to a domain that contains its sample. Boundaries of the domain in the vector space can be expressed analytically with the aid of transformations that cluster samples of a class and separate classes from one another. From these geometrical notions a generalised discriminant analysis is developed which, as the sample size goes to infinity, leads to decision-making that is consistent with the results of statistical decision theory.

2693 **On the definition of a certain class of automata.** M. P. Schutzenberger, North Carolina University, *AD-260709,* Jan. 1961, 33 p., $3.60. This report verifies that a large part of Kleene's Theory of regular events still applies to a class of automata with an infinite set of states.

2694 **A stochastic motor-learning analog.** K. R. Scott, Air Force Cambridge Research Labs., *AD-260218,* Jan. 1961, 16 p., $1.60. This report describes an electromechanical machine capable of learning by trial-and-error to perform a simple motor act.

2695 **Character recognition.** Standard Telephones & Cables Ltd., *B.P. 878931,* 4 Oct. 1961. This patent describes a character recognition system in which a character is scanned along parallel paths simultaneously. By a particular coupling of signals from individual paths and pairs of paths to detecting means such as bistable devices, a particular combination of conditions of the bistable devices is obtained for each character.

2696 **Magnetic ink character recognition.** Gen. Electric Co., *U.S.P. 3000000,* 12 Sept. 1961. This patent describes a system for reading characters written in magnetic ink, in which the magnetic head output is applied to a delay line, the signal amplitude is detected at several sampling points along the delay line, and those signal amplitudes which exceed a certain portion of the maximum signal amplitude are amplified to obtain a voltage pattern representative of the character.

See also:—
General: Ref. 2636.
Applications, Medical: Ref. 2856.

MATHEMATICS

2697 **Asymptotic behavior of the best polynomial approximation.** E. K. Blum and P. C. Curtis, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 645-647. This paper considers the validity of the statement that the best Chebyshev approximation to a real-valued function, defined and continuous on $[-1, +1]$, of degree n is asymptotically equal to the $(n+1)$th coefficient in the Chebyshev expansion. 2 refs.

2698 **The compositeness of the thirteenth Fermat number.** G. A. Paxson, *Maths. of Computation,* **15,** Oct. 1961, 420. Brief account of the determination on an IBM 7090 that the thirteenth Fermat number is composite. 4 refs.

2699 **Efficient continued fraction approximations to elementary functions.** K. Spielberg, *Maths. of Computation,* **15,** Oct. 1961, 409-417. This paper describes an application and extension of the work of H. J. Maehly on the rational approximation of arc tan x and of E. G. Kogbetliantz, who developed Maehly's procedure so as to be applicable to the computer programming of elementary transcendental functions. It is shown that certain modifications, such as the introduction of terms which are easily computed on specific computers, lead to considerable improvements. The application of the modified method to several elementary functions is described and corresponding final results are given. Some of these approximations have been used to develop subroutines for the IBM 704 and 709. 9 refs.

2700 **An evaluation of Runge-Kutta type methods for higher order differential equations.** C. Froese, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 637-644. In this paper, the Runge-Kutta methods for higher order differential equations are outlined. The Rademacher theory of error propagation is used to estimate the propagated errors due to the truncation errors in the formulae when certain equations are solved by Runge-Kutta type methods. These estimates are verified by experimental results obtained on the IBM 704, which also indicate the effect of round-off. An optimum procedure is suggested and a few remarks are made regarding the general case. 8 refs.

2701 **Integration of the general bivariate Gaussian distribution over an offset circle.** A. R. DiDonato and M. P. Jarnagin, *Maths. of Computation,* **15,** Oct. 1961, 375-382. This paper describes an efficient method for the numerical evaluation by a digital computer of the integral of any uncorrelated elliptical Gaussian distribution over the area of an arbitrarily centered circle in the plane. By introducing at most four linear transformations of coordinates, the method can be used to cover the general problem of integrating any correlated or uncorrelated bivariate normal distribution over an arbitrary ellipse in the plane. Results obtained with a NORC program are discussed. 8 refs.

2702 **Iterated square root expansions for the inverse cosine and inverse hyperbolic cosine.** H. C. Thacher, *Maths. of Computation,* **15,** Oct. 1961, 399-403. The availability on several digital computers of square root operations which are approximately as fast as multiplication or division encourages investigation as to the uses which may be made of this operation in computation. This paper describes a set of rapidly converging square root expansions for the inverse cosine, inverse hyperbolic cosine, and hence for the natural logarithm. 2 refs.

2703 **Iterative methods for linear equations with symmetric positive definite matrix.** D. W. Martin and G. J. Tee, *Computer J.,* **4,** Oct. 1961, 242-254. This paper provides a classification and résumé of recently published iterative methods for large systems of linear equations of symmetric and positive definite form. The paper first discusses stationary methods and the fundamental improvement in their performance gained by exploiting certain properties of Chebyshev polynomials. The gradient methods are then described from a geometric viewpoint and interpreted in terms of kernel polynomials. A tentative evaluation of the various methods is made on the basis of recent comparative experiments. 33 refs.

2704 **On least squares solutions of linear equations.** E. E. Osborne, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 628-636. A least squares solution of the set of linear equations $Ax=b$, where A is an $m\times n$ matrix and b is a given n-dimensional column vector, is obtained by solving the n normal equations $A^*Ax=A^*b$. The conditioning of A^*A is worse than that of A which leads to difficulties which cannot be remedied by the application of conditioning processes to the matrix A^*A once it has been formed. This paper is concerned with improving results in the homogeneous case, but the results may be applied to the nonhomogeneous case. The representation of matrix A is first treated. Theorems dealing with the effects of computational errors are then presented; these indicate fairly clearly how the various steps of the computation should be performed. The final section of the paper deals with techniques for ensuring good results. 6 refs.

2705 **Lognormal distribution function for describing anelastic and other relaxation processes I. Theory and numerical computations.** A. S. Nowick and B. S. Berry, *IBM J. Res. & Dev.,* **5,** Oct. 1961, 297-311. Such phenomena as dielectric, magnetic and anelastic relaxation are often described in terms of a distribution of relaxation times. It is shown in this paper that a relaxation process which exhibits a Gaussian distribution in the logarithm of the relaxation times (a "lognormal" distribution) can be specified completely by three parameters. These are: the mean relaxation time, the width of the distribution, and the magnitude of the relaxation. The relationships of these parameters to experimentally measurable functions are usually complicated. These relationships, obtained in nŭmerical form on an IBM 704, are presented. Finally, a simple formula is derived which expresses the width of distribution parameter in terms of the widths of the distribution of the activation energies and that of the attempt frequencies. 9 refs. See also Ref. 2706.

2706 **Lognormal distribution function for describing anelastic and other relaxation processes II. Data analysis and applications.** A. S. Nowick and B. S. Berry, *IBM J. Res. & Dev.,* **5,** Oct. 1961, 312-320. This paper deals with the use of the theory and computations given in Ref. 2705 for a relaxation process governed by a lognormal distribution of relaxation times. The experimental determination of the basic parameters appearing in the theory is shown to require the application of a number of corrections to the usual type of dynamical data. General expressions are derived for these corrections, and the data necessary for their use are presented in graphical form. Specific examples are given of the application of the theory to the analysis of anelastic relaxation phenomena. 10 refs.

2707 **A method for numerical integration.** C. B. Haselgrove, *Maths. of Computation,* **15,** Oct. 1961, 323-337. This paper gives an account of some methods developed for the numerical evaluation of multidimensional integrals. The methods are based on the theory of Diophantine approximation. They are suitable for some problems for which the Monte Carlo method is commonly used and are well fitted for use with a digital computer. It is shown that the methods are superior to the Monte Carlo method provided that the integrand satisfies certain conditions, and also that they are superior, for integrals in space of several dimensions, to formulae typified by those of Gauss and Simpson. The methods may also be superior even to certain new integration formulae specially constructed for the evaluation of multiple integrals. 7 refs.

2708 **Note on "Approximation of curves by line segments".** N. Ream, *Maths. of Computation,* **15,** Oct. 1961, 418-419. This note refers to the paper by H. Stone, *ibid,* **15,** Jan. 1961, 40-47 (*C.A.,* **5,** Feb. 1961, Ref. 247) and discusses the solution of the least-squares equations in connection with designing diode function generators for analogue computers. 4 refs.

2709 **Representation of power series in terms of polynomials, rational approximations and continued fractions.** K. Spielberg, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 613-627. This paper first discusses an IBM 704 program which furnishes polynomial approximations with accuracy up to 16 digits for power series or other polynomials. A method of obtaining efficient rational approximations is then developed which presupposes the existence of such a program. Finally, an IBM 704 program based on the method described is presented and an application to the function $\log_2 x$ is given. The program computes double precision polynomial approximations, and rational and continued fraction approximations; gives error estimates for each approximation; and, if so specified, compares each approximation with the given function at up to 106 points in the interval $(-1\leqq x\leqq 1)$. 12 refs.

2710 **Rigorous error bounds for computed eigensystems.** J. H. Wilkinson, *Computer J.,* **4,** Oct. 1961, 230-241. When an approximate eigensystem of a matrix has been computed it is useful to have some procedure for determining strict bounds for its errors. Since the determination of such bounds will almost inevitably demand further computation, it is not unreasonable to require that the procedure should lead directly to an improved eigensystem, and that it should give bounds for the errors in this improved system rather than in the original. This paper describes procedures of this type for both Hermitian and non-Hermitian matrices. Numerical results obtained on ACE are discussed. 7 refs.

2711 **The solution of non-linear equations and of differential equations with two-point boundary conditions.** C. B. Haselgrove, *Computer J.,* **4,** Oct, 1961, 255-259. This paper describes general methods for the solution of sets of non-linear simultaneous equations as they arise in problems of pure and applied mathematics, where there are often more equations than unknowns (with some implicit redundancy) or more unknowns than equations (with a continuous set of solutions). The basis of the methods is the n-dimensional generalisation of the Newton-Raphson process.

2712 **Symmetric successive overrelaxation in solving diffusion difference equations.** G. J. Habetler and E. L. Wachspress, *Maths. of Computation,* **15,** Oct. 1961, 356-362. This paper refers to 'On the numerical solution of elliptic difference equations', J. W. Sheldon, *Math. Tables & Other Aids to Computation,* **9,** 1955, 101, in which an iterative scheme was presented for solving certain elliptic difference equations. The computational experiments described in that paper indicated that the method was superior to the method of successive overrelaxation. It is shown in the present paper that this conclusion is valid for the model problems considered by Sheldon but that it is not valid for general diffusion difference equations. Theoretical convergence of the method is established, a variational scheme for estimating the optimum parameters is developed and numerical results obtained on an IBM 704 for some typical diffusion calculations encountered in nuclear reactor theory are given. 5 refs.

2713 **Application of the method of the kernel function for solving boundary value problems.** S. Bergman and J. G. Herriot, Stanford University, *AD-243976 (PB 152362),* 1 Sept. 1960, 49 p., $4.60. Boundary value problems involve the determination of a function which satisfies a given partial differential equation inside a domain and which assumes prescribed values on the boundary of this domain. The method of the kernel function consists of (1) generating a (complete) set of particular solutions of the partial differential equation, (2) deriving from this system a set of particular solutions which are orthonormal in a suitable sense over a given domain, and (3) determining from the prescribed boundary values a linear combination approximating the desired solution. Computational procedures are discussed for application of a digital computer. The discussion is restricted to the case of Laplace's equation. A domain with a symmetric boundary is considered, and only the case of symmetric boundary values is studied. The method of kernel functions also enable one to find the mapping function which maps a given simply-connected domain conformally on to a circle. For the symmetric domain, an approximation to the mapping function is obtained, and this mapping function is found to map the domain on to a nearly circular region. 14 refs.

2714 **Simulation as experimental mathematics.** J. R. Jackson, University of California, Los Angeles, *AD-260337,* 22 June 1961, 10 p., $1.60. Computational experimentation is described using simulators as a means for realising abstractly defined mathematical models. The experimental work is closely integrated with related mathematical analysis.

See also:—
General: Ref. 2638.
Learning and Pattern Recognition: Ref. 2674.
Techniques: Ref. 2715.
Programming: Ref. 2789.
Applications, Nuclear: Ref. 2858.

TECHNIQUES

2715 **An a priori determination of serial correlation in computer generated random numbers.** M. Greenberger, *Maths. of Computation,* **15,** Oct. 1961, 383-389. This paper refers to 'Serial correlation in the generation of pseudo-random numbers', R. R. Coveyou, *J. Assn. Computing Mchy.,* **7,** Jan. 1960, 72-74 (*C.A.,* **4,** April/May 1960, Ref. 613) in which there was given an approximate formula for the serial correlation between a number and its immediate successor in a full sequence of pseudo-random numbers generated by the mixed congruential method. In this paper, it is shown that under certain conditions Coveyou's approximate formula can fail badly and a correction term which overcomes this limitation is derived. 12 refs.

2716 **The automatic determination of human and other system parameters.** T. F. Potts, G. N. Ornstein and A. B. Clymer, *Proc. Western Joint Computer Conference,* 1961, 645-660. This paper is concerned with the problem of determining the parameters of any given dynamic system by automatic methods on an analogue or digital computer. Various computer methods for the determination of system parameters from dynamic test data are reviewed and compared. Two applications of a method (on the absolute magnitude of the system-equation-satisfaction error) are reported. In the first, simultaneous automatic analogue determination of four coefficients in a human response equation (transfer function) is accomplished. The second application of the technique is in an analogue determination of aerodynamic coefficients from simulated flight test data. The paper concludes with a brief discussion of a broad range of potential applications of methods for the determination of the parameter values required for computer simulation of human systems, other biological systems, socio-economic systems, and physical systems of concern in science and engineering. 45 refs.

2717 **A goodness of fit test.** M. Hershkowitz, *Commun. ACM,* **4,** Oct. 1961, 465. Letter giving brief details of a FORTRAN program for testing the 'goodness of fit' of the distribution of actual data to the Poisson and negative binomial probability distributions.

2718 **Internal sorting and external merging.** M. A. Goetz, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 649-650. Letter referring to 'Analysis of internal computer sorting', I. Flores, *ibid,* **8,** Jan. 1961, 41-80 (*C.A.,* **5,** Sept. 1961, Ref. 1889) and to 'An answer to Mr. J. A. Lively's remarks on the paper "Amphisbaenic sorting" ', H. Nagler, *ibid,* **8,** Jan. 1961, 117 (*C.A.,* **5,** Sept. 1961, Ref. 1890), and pointing out, in each case, a technique not mentioned in the above citations.

2719 **An iteration procedure for parametric model building and boundary value problems.** W. Brunner, *Proc. Western Joint Computer Conference,* 1961, 519-533. One of the problems frequently encountered in simulating a physical system on an analogue computer is the problem of finding the value of the parameters typifying the system so that the system outputs will have desired performance characteristics. This paper presents a steepest descent iterative approach based on least squares error minimisation which automates the optimisation process so that the system engineer can simply specify the performance criteria and then let the computer itself do the laborious task of finding the optimum set of parameters. The iteration process is shown to converge under fairly general conditions provided the initial guess lies in a neighbourhood of the true optimum. An automatic gain control assures stability of the iteration procedure, which is a single step iteration process, i.e., only one parameter is updated at a time. The optimisation procedure may also be applied to the problem of determining the parameters defining a physical system by comparing the outputs of the physical system with those of an approximate model simulated on an analogue computer. The same procedure can be applied to home in on boundary conditions in ordinary differential equations. 5 refs.

2720 **A note on burst detecting sum codes.** J. M. Berger, *Information & Control,* **4,** Sept. 1961, 297-299. This note is concerned with a simple extension of the sum codes described in 'A note on error detection codes for asymmetric channels', *ibid,* **4,** March 1961, 68-73 (*C.A.,* **5,** May 1961, Ref. 901), which allows the detection of bursts of errors of any desired length while still detecting all possible errors in a completely asymmetric channel. The code described is a sum code in which the weights associated with the information bit positions are chosen to accomplish the desired burst error detection. With the use of approximately $k+\log_2(n/k)$ redundancy bits, where n is the number of information bits, the code will detect all bursts of errors of length k or less in any channel.

2721 **A solution to the transportation problem programmed for the Burroughs 220 computer.** P. Sassouni, *Elektronische Datenverarbeitung,* No. 5, 1961, 203-209. This paper describes a method, which has been programmed for the Burroughs 220, for solving the transportation class of linear programming problems. An iterative algorithm, which is an adaptation of the Simplex method applied to the system of equations of the associated linear programming problem, is used to converge the objective function to the optimum, starting with an initial basic feasible solution. An example of the use of the method is given. 3 refs.

2722 **Some orthogonal methods of curve and surface fitting.** J. H. Cadwell and D. E. Williams, *Computer J.,* **4,** Oct. 1961, 260-264. Extensions of the Forsythe method of curve fitting to surface fitting with a general set of data points are described. Attention is drawn to the use of the Gram-Schmidt process in such problems. The fitting of curves defined by the product of a known function and an arbitrary polynomial is discussed. This procedure is applied to defining a curve with vertical tangents or vertical asymptotes, and to fitting a polynomial satisfying certain restrictions at a specified point. Programs have been written in the Autocode system for the Ferranti Mercury. 5 refs.

2723 **The spectral evaluation of iterative differential analyzer integration techniques.** M. C. Gilliland, *Proc. Western Joint Computer Conference,* 1961, 507-518. The iterative differential analyser can use numerical integration techniques as part of its mathematical repertoire; in this paper, these techniques are compared and evaluation from the control system point of view. The W-transform, a special case of the modified Z-transform, is used as a base for analysis. The true numerical integration operator is shown to have the form $T(\log w)^{-1}$ where T is the time increment for the process. The truncation error for an integration process is related to the dynamic error of the corresponding integration operator which is determined by comparison with $T(\log w)^{-1}$. Various integration operators are evaluated with respect to dynamic error. Parasitic solutions are shown to correspond to poles of the W-transfer function of the operator. Round-off error accumulation may be determined from the W-plane representation of the operator. Synthesis of open-loop operators using root-locus and Bode techniques is discussed. Closed-loop operator selection and stability for the integration of linear ordinary differential equations is discussed. Techniques are indicated for the stabilisation of closed-loop operators. Techniques are presented for the determination of truncation and round-off error estimates for the integration of linear ordinary differential equations. 4 refs.

2724 **On various versions of the defective coin problem.** R. Bellman and B. Gluss, *Information & Control,* **4,** Sept. 1961, 118-131. The problem of ascertaining the minimum number of weighings which suffice to determine the defective coin in a set of coins of the same appearance, given an equal arm balance and the information that there is precisely one defective coin present, is well known. This paper analyses the far more complex problem which arises when there are known to be two or more defective coins present. The purpose of the paper is to indicate a systematic way in which the theory of dynamic programming can be used to provide a computational solution to the determination of optimal and suboptimal testing policies. Numerical results obtained with a UNIVAC 1105 are discussed. 9 refs.

2725 **An analytic iterative rotation program for the IBM Type 709.** G. Burket, Washington University, Seattle, *AD-260022,* July 1961, 4 p., $1.10. This program performs an orthogonal rotation of an arbitrary factor loading matrix with the criterion that the variance of the squared factor loadings be a maximum for each successive simple structure approximation vector.

2726 **A generator of pseudo-random binary numbers.** D. M. Jones, Radio Corp. of America, *AD-261353,* April 1961, 26 p., $2.60. The purpose of this study was to design and test a program capable of generating sequences of pseudo-random binary digits in which the probability of a 1 occurring possesses some pre-assigned value, *po* say (and hence the probability of a 0 occurring is 1-*po*). The parameter *po* can take values in the range (0, 1/2). It is called the Transition Probability, by analogy to the binary symmetric communication channel, and pseudo-random binary sequences of the type described can in fact be used to simulate noise in such a channel. This report describes two programs written for STREAC. The first program generates and prints out sequences of pseudo-random binary digits, the second program accumulates and prints out certain statistics relating to these sequences. The statistics can be used to test for apparent randomness. Conditions were found under which the generator gives satisfactory results on the basis of the empirical tests made. Details of the testing procedure and the numerical results obtained are described.

2727 **POLFIT II, an IBM 7090 program for polynomial least squares fitting.** M. P. Lietzke, Oak Ridge National Lab., *ORNL-3132,* 24 April 1961, 27 p., $0.75.

2728 **A program for computing probabilities over rectangular regions under the multivariate normal distribution.** A. Hillier, Stanford University, *AD-261283,* 28 July 1961, 17 p., $1.60. A machine program is given for computing probabilities of multivariate normally distributed random variables beyond the dimension three.

2729 **Special binary digital code patterns.** W. Horenstein, Naval Ordnance Lab., *AD-250212 (PB 154216),* 15 Nov. 1960, 57 p., $5.60. A study is made of two groups of binary codes consisting of odd numbers of digits. Multiplication of any one of these sequences by a decoding matrix results in a row matrix which produces a distinctive type of pulse pattern. The elements of the row matrix—identical with autocorrelation functions—consist of plus ones or minus ones and zeros except for the autocorrelation function of zero, where the matrix element is numerically equal to the number of digits in the code. The presentation includes a derivation of the general term of a sequence, synthesis of specific code values, and an analysis of permissible code values. 3 refs.

See also :—
General: Ref. 2638.
Mathematics: Refs. 2701, 2703, 2707, 2709, 2710, 2711 and 2712.

ACCESSORIES

2730 **Clock recovery or rephaser circuit.** J. D. Bagley, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 18. Description of a system whereby synchronisation of clock signals is achieved at different locations by using signals on data input lines rather than separate synchronising lines between the different clocks.

2731 **Data-Phone.** *Data Processing (London),* **3,** Oct.-Dec. 1961, 248-251. A brief account is given of the Bell Data-Phone system for data transmission and of its applications.

2732 **Fiber optics large scale read-only memory.** G. D. Bruce and M. A. Every, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 76-77. A description is given of an optical read-only memory in which selection is effected by means of a cathode ray tube having on its screen a raster of address locations each connected by a separate light-conducting rod, or optical fibre, to a corresponding index point on the upper surface of a stack of light-conducting plates. At each index point a light-conducting information storage rod extends downwardly through all the plates. Information is stored permanently in a rod by providing light apertures at selected bit locations. Light transmitted to a selected storage rod from the cathode ray tube is gated into one or more plates by the aperture or apertures on the selected rod and is channelled from an exit point at the edge of each plate to readout means such as an array of photocells.

2733 **File protect mechanism.** E. D. Barkhuff, H. E. Childs, F. A. Schultz and D. N. Streeter, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 8. Brief description of electro-mechanical arrangements for preventing inadvertent erasure of master data on a magnetic tape.

2734 **Get maximum reliability from digital magnetic tape.** K. Taylor, *Control Engng.,* **8,** Oct. 1961, 113-115. This article discusses how reliability of a digital magnetic tape recorder can be increased by techniques such as opening of the head gap, reducing the bandwidth of the read detection system and purposely operating the tape out of contact with the head.

2735 **A high track-density servo-access system for magnetic recording disk storage.** A. S. Hoagland, *IBM J. Res. & Dev.,* **5,** Oct. 1961, 287-296. This paper is concerned with an investigation of the feasible track-density potential of random access magnetic disc storage where magnetic head positioning is essential. Primary emphasis is given to a novel, servo-access concept (closed-loop head positioning control which includes the record member) for track location and registration. This servo concept has been investigated as a means of making possible automatic tracking as well as precision positioning. Inherent in such an access control technique is an enhanced suitability for interchangeable record members. Included in the discussion are design and performance results of an access model operated at 154 tracks per inch.

2736 **A coding problem arising in the transmission of numerical data.** R. C. Bose and I. M. Chakravarti, North Carolina University, *AD-260708,* April 1961, 15 p., $1.60. A biunique coding from the set of the 2^n integers, 1, 2, . . . 2^n onto the set of the 2^n n-place binary sequences is shown. It has some minimal properties.

2737 **Data transfer.** G. Dirks. *B.P. 879295,* 11 Oct. 1961. This patent describes arrangements for the transfer of data from a data source such as a magnetic tape to a main magnetic drum store which is not synchronised with the data source.

2738 **Digital computer input system.** Burroughs Corp., *U.S.P. 3000555,* 19 Sept. 1961. Arrangements are described whereby instructions and data stored on punched tape or similar storage medium are utilised directly by a digital computer without the use of intermediate stores.

2739 **Data converter.** Burroughs Corp., *U.S.P. 3000556,* 19 Sept. 1961. This patent describes computer input-output arrangements employing a magnetic drum buffer between a punched card reader or punch and the computer. Format control bands on the drum are used to program the transfer of bits onto or off the drum.

2740 **Magnetic head positioning device.** Ex-Cell-O Corp., *U.S.P. 3001181,* 19 Sept. 1961. This patent describes a device for setting and locking the heads of a magnetic drum.

See also:—
Digital: Ref. 2784.
Applications, Control—Production and Process: Ref. 2833.

ELEMENTS

2741 **Asynchronous multiplier.** C. J. Tilton, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 21. Description of a control circuit for a digital multiplier, which eliminates the need for a clock producing pulses for control of the multiply operation. The control circuit provides each partial product with a cycle or period which is of variable duration, depending on whether only a shift, or an add plus a shift operation is required.

2742 **Capacitor-coupled, neon-photoconductor flip-flop.** M. Corradetti, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 70-71. Description of a two neon flip-flop in which coupling with a single capacitor provides positive switching with no switch-off delay.

2743 **The Chargistor, a new class of semiconductor devices.** H. N. Yu, *IBM J. Res. & Dev.,* **5,** Oct. 1961, 328-330. Letter describing a new class of semiconductor devices called Chargistors. Each device is composed of a bar of either P-type or N-type high resistivity semiconductor material to which a number of rectifying contacts or control electrodes are attached. The conduction through the bar due to hole injection at one end and electron injection at the other is limited by space charges. The space charge region exists because both holes and electrons recombine in the intrinsic body. The potential and space charge distribution in the body can be changed by the action of the control electrodes which cause the current flow to be modulated. 3 refs.

2744 **Combined analog/digital computing elements.** H. Schmid, *Proc. Western Joint Computer Conference,* 1961, 299-314. This paper describes three computing elements (multiplier, integrator and function generator) whose accuracy is higher than that of comparable analogue devices and whose speed is faster than that of comparable digital circuits. These elements employ both analogue and digital computing techniques and the input and output signals are represented by two quantities, the most significant part by a parallel binary number and the least significant part by an analogue voltage. It is emphasised that pure digital techniques, not digital differential analyser techniques, are used. The hybrid multiplier consists of a relatively simple digital multiplier, three digital-to-analogue converters, a very simple analogue multiplier and a summing and comparison circuit. An accuracy of 0.01% and a bandwidth of 1 kc/s is possible with a relatively simple circuit. The hybrid integrator consists of an accumulating register, a variable amplitude sawtooth generator, a simple analogue integrator and a summing and comparison circuit. The hybrid function generator consists of a diode decoding matrix, a diode translation matrix, two digital-to-analogue converters and a summing and comparison circuit. 6 refs.

2745 **Counter with simultaneous carry.** W. N. Carroll and R. A. d'Antonio, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 12-13. A binary counter is described, comprising a number of triggers in which binary numbers are registered in true form, if odd, and in complement form, if even. Counting is speeded up since all complement operations are performed in parallel, eliminating carry propagation and it is arranged that the output always appears in true form, despite the fact that the numbers are alternately in true and complement form.

2746 **The development of a multiaperture reluctance switch.** A. W. Vinal, *Proc. Western Joint Computer Conference,* 1961, 443-474. This paper describes the development of a substantially improved transfluxor type device called the Multiple Apertured Reluctance Switch (MARS). The MARS is similar to the classic transfluxor in that it comprises square loop magnetic material embodying two apertures. It has been found, however, that the necessity for the large aperture of the transfluxor can be eliminated and the two apertures of the MARS have substantially the same inner perimeter. This makes it possible to develop a practical three-dimensional coincident current, nondestructive readout memory. 7 refs.

2747 **Logical branching core.** R. S. Hill, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 41. A description is given of a multiaperture ferrite core which provides both an OR and a NOR function.

2748 **Low-cost triangle-integration multipliers for analog computers.** J. Hartman, G. A. Korn and R. L. Maybach, *Ann. Assn. Int. Calcul Analogique,* **3,** Oct. 1961, 167-172. This paper describes the circuit of a simple multiplier which achieves a static accuracy of 0.1% at very low cost. Only two dc amplifiers sharing a common chopper are required, and a single two-tube triangle generator suffices for several multipliers. 9 refs.

2749 **Magnetic continuous film sandwich array.** E. W. Pugh and J. C. Suits, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 36. Description of a memory array structure which avoids demagnetising effects, associated with individual thin magnetic film bits, caused by the film edges. Two drive lines and a sense line are sandwiched between two continuous thin film sheets of permalloy. A binary storage cell is defined by areas of both sheets common to the cross-over area of the drive lines.

2750 **Memory.** J. W. Conley, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 51. Description of a memory matrix employing an orthogonal array of Esaki diodes, each associated with a load resistor of such value as to provide a bistable combination.

2751 **Monostable trigger.** G. D. Brode and T. D. Ward, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 65. A transistor monostable trigger circuit using complementary symmetry is described in which power dissipation during the quiescent state is reduced as both transistors are then non-conductive.

2752 **A nondestructive readout film memory.** R. J. Petschauer and R. D. Turnquist, *Proc. Western Joint Computer Conference,* 1961, 411-425. This paper gives an account of the BICORE memory element and of model memories which utilise it. Two thin films are used for each BICORE memory element: one of high-coercivity cobalt-iron alloy and the other of low-coercivity nickel-iron alloy. The former is used to store the bit while the latter senses it. The films are deposited in a multi-layer fashion onto a single glass substrate. The film cores are circular discs with a diameter of 0.050 in. and placed on 0.100 in. centres and fabricated in 16×18 arrays. Design and operating characteristics are given for a model memory containing 16 18-bit words. Read currents can vary over a 2:1 range without producing errors. Temperature and other environmental factors do not appreciably affect performance. Details are also given of a 1024-word 36-bit memory. 5 refs.

2753 **Optimization of analog computer linear system dynamic characteristics.** C. H. Single and E. M. Billinghurst, *Proc. Western Joint Computer Conference,* 1961, 315-339. The characteristics of the linear computing elements (resistors, capacitors, coefficient potentiometers, operational amplifiers) of the general purpose electronic differential analyser are discussed. Equivalent circuits are given for these elements. Criteria for optimisation of the linear computing system in order to obtain maximum computational accuracy are given. Examples are presented of the effects of optimisation in improving system stability, transient response and increasing bandwidth of high and medium accuracy computation. 12 refs.

2754 **Pulse distributor.** W. N. Carroll and D. J. Hinkein, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 72. A description is given of a pulse distributor which takes pulses from a single pulse source and establishes pulses on each one of a plurality of output conductors sequentially, the circuit dispensing with the need for a dc bias source for control purposes in each stage.

2755 **Register input-output gate.** L. Weiss, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 73. A circuit is described which employs neons and photocells and performs the dual function of gating information either into or out of a register.

2756 **Shift register and binary triggers.** J. Earle. *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 53-54. A description is given of a sequential switch which functions as a single bit position of a shift register, and of two binary triggers, all employing NOR circuits.

2757 **Ternary logic switch.** H. B. Baskin, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 58-59. Particular values of biasing and supply potentials, and relative values of input resistors are specified for a ternary logical circuit employing transistors.

2758 **Transistor-diode latch.** L. K. Lange, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 60. Description of a bistable latch circuit employing an emitter follower and a diode having a slow recovery characteristic enabling it to store a charge.

2759 **Transistor flip-flop.** J. Earle, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 68-69. A description is given of a two-collector transistor circuit which operates as a dc flip-flop.

2760 **Tunnel diode NOR and NAND circuits.** D. P. Masher, *IBM Technical Disclosure Bull.,* **4,** Oct. 1961, 55. A description is given of a circuit employing two tunnel diodes in series which provides signal inversion and hence such logic functions as NOR and NAND.

2761 **Tunnel diode storage using current sensing.** E. R. Beck, D. A. Savitt and A. E. Whiteside, *Proc. Western Joint Computer Conference,* 1961, 427-442. Tunnel diodes are attractive for use as the basic elements in high speed, random access memories because of their fast switching speed and good environmental tolerance. This paper describes a tunnel diode memory element and a matrix employing such element. Each element consists of one tunnel diode and one resistor. Since the element provides no isolation between drive currents and sense output, the form of the matrix is arranged to provide the required isolation. Test results indicate that a 200-ns cycle time can be obtained in a memory of 64 words of 24 bits each. With further circuit refinements it is hoped to obtain a cycle time of 100 ns or less over the temperature range of $-55°$ to $+125°$C. 4 refs.

2762 **Wide temperature range coincident current core memories.** R. S. Weisz and M. Rosenberg, *Proc. Western Joint Computer Conference*, 1961, 207-214. This paper first discusses the problem of operating ferrite core memories over a wide temperature range (specifically −55° to +125°C.) and reviews previous approaches to the solution of the problem. It then describes the characteristics of cores employing a new family of square loop ferrite materials with a low temperature coefficient of coercivity. Finally, the characteristics of a coincident current array employing the new cores are briefly described. 6 refs.

2763 **Electroluminescent/photoconductor data store.** Nat. Research Development Corp., *B.P. 879660*, 11 Oct. 1961. This patent describes a storage matrix employing electroluminescent elements each series-connected to a photoconductor element.

2764 **Superconductive switch.** Standard Telephones & Cables Ltd., *B.P. 880459*, 25 Oct. 1961. A superconductive switching element is described in which the gate conductor and the conductor forming the solenoid surrounding the gate both consist of metal films supported by a substrate which is an effective insulator at least at temperatures at which the gate conductor is superconductive.

2765 **Serial full adder.** Int. Business Machines Corp., *U.S.P. 2998918*, 5 Sept. 1961. This patent describes circuit arrangements for serially adding two binary numbers to produce a sum with a minimum of delay.

2766 **Analogue memory.** Sperry Rand Corp., *U.S.P. 2999228*, 5 Sept. 1961. A description is given of a memory device for analogue computers, which comprises two mechanically driven potentiometers arranged so that resynchronisation is not required after a storing period.

2767 **Shift register.** Int. Business Machines Corp., *U.S.P. 2999229*, 5 Sept. 1961. A shift register is described which employs solid state circuit elements (germanium bars, for example) which are maintained at a low temperature such that they are readily switched from conducting to non-conducting state.

2768 **Adder employing majority logic elements.** Hughes Aircraft Co., *U.S.P. 2999637*, 12 Sept. 1961. Parallel and serial binary adders employing majority logic elements are described.

2769 **Analogue multiplier.** Sperry Rand Corp., *U.S.P. 2999639*, 12 Sept. 1961. A description is given of an analogue multiplying circuit employing only passive components and which uses the principle of transverse magnetisation of magnetic cores.

2770 **Magnetic wire memory array.** Bell Telephone Labs., Inc., *U.S.P. 3000004*, 12 Sept. 1961. A magnetic wire memory designed to have an improved signal-to-noise ratio is described.

2771 **Analogue multiplier.** U.S. Secretary of the Navy, *U.S.P. 3000565*, 19 Sept. 1961. This patent describes a circuit for four quadrant analogue multiplication which includes saturable reactors and diode shaping networks.

2772 **Superconductive memory.** Arthur D. Little Inc., *U.S.P. 3001178*, 19 Sept. 1961. This patent describes a memory unit which includes a cryotron flip-flop and a matrix employing such units.

2773 **Pre-wired cryotron memory.** Arthur D. Little Inc., *U.S.P. 3001179*, 19 Sept. 1961. A description is given of a cryotron array suitable for use as a fixed memory.

2774 **Magnetic core matrix for arithmetic operations.** Int. Business Machines Corp., *U.S.P. 3001710*, 26 Sept. 1961. This patent describes matrices of bistable magnetic cores for addition and for multiplication.

2775 **Serial adder.** Nat. Cash Register Co., *U.S.P. 3001711*, 26 Sept. 1961. A transistor circuit for a serial binary adder is described.

2776 **Beam switching tube logic circuit.** Int. Business Machines Corp., *U.S.P. 3001712*, 26 Sept. 1961. This patent describes a basic beam switching tube circuit which can be modified to perform many logical operations. A binary full adder is described as an example.

2777 **Ferroelectric data storage matrix.** Bell Telephone Labs., Inc., *U.S.P. 3002182*, 26 Sept. 1961. This patent describes a ferroelectric capacitor matrix designed so as to reduce the effect of disturbing pulses.

See also:—
Design: Ref. 2646.

ANALOGUE

2778 **A digital control unit for a repetitive analog computer.** T. A. Brubaker and H. R. Eckes, *Proc. Western Joint Computer Conference*, 1961, 353-360. This paper describes a digital control unit for the University of Arizona's repetitive analogue computer. The control unit combines a 10 kc/s crystal oscillator with inexpensive preset decimal counters and simple digital circuitry to generate accurate timing pulses which perform the following functions: (1) Reset a repetitive analogue computer at 100, 50, 25 or 10 c/s or on external triggering; (2) Actuate external equipment during a preset number of 1,000 to 10,000 successive computer runs; (3) Furnish sampling pulses to sampling readout devices at push-button selected samping times t_1 and t_2 seconds after the start of each computer run; (4) Furnish variable-brightness oscilloscope timing markers at 1,000, 500, 250 and 100 c/s, markers also being available at the computer repetition rate and at times t_1 and t_2. 2 refs.

2779 **The state of analogue computation.** R. J. A. Paul, *Control*, **4,** Oct. 1961, 106-107. A personal informal report of the Third Conference on Analogue Computation, Opatija, Yugoslavia, 9 September 1961. Current trends in analogue computation are listed and some of the highlights of the papers are discussed.

DIGITAL

2780 **Atlas.** *Data Processing (London)*, **3,** Oct.-Dec. 1961, 254-260. An account is given of some of the main features of the Ferranti Atlas.

2781 **Computer equipment comparisons.** *Control Engng.*, **8,** Oct. 1961, 105-107. Introduction to a series of articles which will compare the features and characteristics of digital computers, analysing the performance of central processors and input-output equipment including punched card devices, magnetic tape units, punched tape equipment, random access devices and printers. For the first article see Ref. 2784

2782 **Data processing for the smaller office—the NCR 390 computer.** *Data Processing (London)*, **3,** Oct.-Dec. 1961, 210-219. A general account is given of the NCR 390 and the data processing tasks that it can perform. A particular feature of this data processing system is the use of magnetic ledger cards from which printed information can be read visually and magnetically recorded data can be read automatically.

2783 **The FX-1 computer at Lincoln Laboratory.** J. A. Kessler, *Computers & Automn.*, **10,** Oct. 1961, 1B-8B. General description of the FX-1 computer now in operation at the M.I.T. Lincoln Laboratory and claimed to be the fastest digital computer ever built. The read-write cycle time for the central memory is 0.3 microseconds and the logic circuits operate at an effective clock rate of 50 million pulses per second.

2784 **Punched card equipment for medium size computers.** *Control Engng.*, **8,** Oct. 1961, 108-112. This article discusses, defines and tabulates for comparison the significant features and performance data on punched card input and output devices available as standard equipment with the following medium size digital computers: Burroughs B200 and B250, Control Data 160A, GE 225, Honeywell 400, IBM 650 and 1401, NCR 304 and 315, Philco 2400, RCA 301, Univac UFC, USS 80 or 90, and USS II.

2785 **A total system concept.** P. D. King, *Data Processing (Detroit)*, **3,** Oct. 1961, 11-14, 56. A general account of the Burroughs B5000 Information Processing System.

2786 **Digital differential analyser.** A. V. Roe & Co., Ltd., *B.P. 880014*, 18 Oct. 1961. This patent describes a digital differential analyser comprising storage and arithmetic sections such that changes in any integrand, any independent variable and any integral are represented by a pulse in one circuit to represent an increment, in another circuit to represent a decrement while no pulse represents a zero change.

2787 **Digital computer.** Alwac International Inc., *U.S.P. 2999636,* 12 Sept. 1961. This patent describes, in some detail, a general purpose digital computer designed for compactness and low cost by utilising to the greatest possible extent interchangeable component circuit units. The computer operates in binary and employs magnetic drum storage.

PROGRAMMING

2788 **ALGOL 60 comment.** M. E. Conway, *Commun. ACM,* **4,** Oct. 1961, 465. Letter commenting on a particular point regarding the ALGOL 60 Report raised in 'ALGOL 60 confidential', D. E. Knuth and J. N. Merner, *ibid,* **4,** June 1961, 268-272 (*C.A.,* **5,** Sept. 1961, Ref. 1998).

2789 **ALGY—an algebraic manipulation program.** M. D. Bernick, E. D. Callender and J. R. Sanford, *Proc. Western Joint Computer Conference,* 1961, 389-392. In a great variety of scientific problems, the reduction of complex analytical expressions is highly desirable but often such reductions, although straightforward, are extremely lengthy and laborious. This paper describes ALGY, a program which accepts alphanumeric algebraic expressions as input and outputs a similar set of modified expressions. ALGY is an interpretive routine which enables the programmer or mathematician to instruct the computer to perform certain algebraic manipulations. The paper includes definitions of the ALGY operations used to obtain the desired results, an explanation of the flow of the program, an example of an ALGY program, and a brief outline of future operations to be included in the program.

2790 **An automatic sequencing procedure with application to parallel programming.** E. S. Schwartz, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 513-537. An automatic sequencing procedure for assigning sets of instructions to predesignated autonomous units of a multiprocessor is described. The procedure is based upon an assignment matrix developed from a precedence matrix. By associating a column vector whose elements are the operation time of each instruction set with the assignment matrix, numerical computation is made possible. A topological index, the precedence number, stating the position of each instruction set in relation to the last set in its path is contained in a second column vector. A transfer matrix in conjunction with an automatically derived path table is employed in a multipath program. Six generalised rules are derived for the procedure which proceeds directly to a solution without obtaining and testing all permutations of the sets of instructions, and seeks to establish a sequence of operations to minimise the total operation time while satisfying all precedence restrictions. Since the procedure does not require looking at the last instruction set before releasing the first sets for assignment to units, computer processing may start after the first assignment period is completed with processing and subsequent sequencing taking place concurrently. The procedure is readily adaptable to computer operation and automatic development of the assignment martix is described. A flow chart of the procedure and its use for solution of a problem is presented. 11 refs.

2791 **Correspondence.** D. A. Bell, *Computer J.,* **4,** Oct. 1961, 229, 241. Letter commenting on the LISP programming system as described in 'Atoms and lists', P. M. Woodward and D. P. Jenkins, *ibid,* **4,** April 1961, 47-53 (*C.A.,* **5,** June 1961, Ref. 1259).

2792 **Current problems in automatic programming.** A. Opler, *Proc. Western Joint Computer Conference,* 1961, 365-369. After a discussion of the increased requirements for automatic programming systems, some of the more promising suggestions for enabling automatic programming to keep pace with other developments are examined. Among the prospects are: standardisation of source languages, development of a standard universal intermediate language, design of computers to operate directly in source language, automatic translation of programs between computers, automatic construction of compilers, and the standardisation and construction of common compiler modules.

2793 **A descriptive language for symbol manipulation.** R. W. Floyd, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 579-584. The author claims that, although the traditional flowchart serves well as a descriptive language for numerical algorithms, it does not lend itself to description of symbol manipulation algorithms in such a way that the intent of the process is clear. This paper presents a more suitable notation for description of compilers and other complicated symbol manipulation algorithms. 2 refs.

2794 **A first version of UNCOL.** T. B. Steel, *Proc. Western Joint Computer Conference,* 1961, 371-378. This paper outlines a first attempt at providing an UNCOL (UNiversal Computer Oriented Language). By means of a program called a generator, specific to a given problem language, program statements in that language are transformed into UNCOL statements; by means of a program called a translator, specific to a given computer, UNCOL statements are converted into the machine language of that computer. UNCOL, as specified in this paper, is a language akin to a symbolic assembly language for a register-free, single address, indexed machine. The specific commands are few in number and simple in construction, depending on a special defining capability for the expression of more elaborate instructions. The data referencing scheme is complex, allowing the application of a signed index to the primary address, and permitting both the primary and index parts to be delegated to an indefinite level. Each item of data, either input or calculated, must be described as to type, range precision and the like by special data descriptive syntactical sentences in the language. 9 refs.

2795 **Improving problem-oriented language by stratifying it.** P. R. Bagley, *Computer J.,* **4,** Oct. 1961, 217-221. This paper is a result of a search for principles to guide the further development of programming language. It is the thesis of the paper that in order to lighten the burden of programming, further development of problem-oriented computer languages must take place in the direction of relieving the programmer of specifying those details which in theory can be supplied mechanically (that is, by programs). The paper outlines and discusses the stratification of programming language into four levels, so that the programmer may concentrate on and state separately the following types of information: (1) The procedures and the data description (in the abstract) devoid of expressions concerned with anything other than the intellectual method of problem solution; (2) The essential constraints on the intellectual or abstract solution of the problem, such constraints being largely concerned with physical formats of inputs and outputs; (3) The implementation details, such as the internal format and coding of data, storage allocation, conversion of procedure into machine instructions; (4) Information about the program, which cannot be mechanically deduced, and which can be given at the programmer's option for the sake of efficiency, such as the relative probabilities of specific choices at a decision point. 6 refs.

2796 **The JOVIAL Checker: an automatic checkout system for higher level language programs.** M. Wilkerson, *Proc. Western Joint Computer Conference,* 1961, 397-404. This paper gives an account of the JOVIAL Checker designed and developed by System Development Corporation for use in checking out programs written in JOVIAL. JOVIAL is a higher level programming language with the 'item' as its basic unit of data. The Checker is a program which executes translated JOVIAL programs and selectively records test results in JOVIAL language. It is part of a system which includes a compiler and the Checker. The compiler checks legality of JOVIAL statements, translates to binary code for a specific machine, and produces a JOVIAL program listing. The Checker operates the object program and 'snaps' every modified value of selected items. Basis of selection may be items of interest to the programmer, items whose final values differ from programmer-supplied, expected values or both. Each modified item value is printed with the statement which modified its value at that point and an associated label. 1 ref.

2797 **The Manchester University Atlas operating system Part I: Internal organization.** T. Kilburn, D. J. Howarth, R. B. Payne and F. H. Sumner, *Computer J.,* **4,** Oct. 1961, 222-225. The organisation of input and output on the Atlas is described. This is controlled by the supervisor program, and uses varying amounts of core and drum store, supplemented where necessary by magnetic tapes, to obtain, when possible, the maximum overlap between input, computing and output. The system will be used on the Manchester University Atlas, but is suitable for any Atlas installation. See also Ref. 2798.

2798 **The Manchester University Atlas operating system Part II: Users' description.** D. J. Howarth, R. B. Payne and F. H. Sumner, *Computer J.,* **4,** Oct. 1961, 226-229. The Atlas operating system (see Ref. 2797) is described from the point of view of the user. Simple additional statements required from the programmer are supplied to the computer rather than to a human operator.

2799 **A method of combining ALGOL and COBOL.** J. E. Sammet, *Proc. Western Joint Computer Conference,* 1961, 379-387. This paper proposes a method of combining ALGOL and COBOL to produce a new language called ALABOL (ALgorithmic And Business Oriented Language) which would contain major portions of ALGOL and COBOL as subsets. The basic principle of the approach adopted was that neither language should have its basic structure altered in order to conform to the other. The major and conceptual differences are listed and described under the headings: type of problem to be solved; general usage of the language; symbolism; data description; input-output. Four types and levels of interchangeability are listed and described: transliteration of basic symbols; transliteration of groups of symbols; translation of groups of symbols; arbitrary differences. The changes which must be made in each language to have the languages coincide in the areas where they basically overlap are outlined. 2 refs.

2800 **NEBULA: a programming language for data processing.** T. G. H. Braunholtz, A. G. Fraser and P. M. Hunt, *Computer J.,* **4,** Oct. 1961, 197-211. An account is given of NEBULA (Natural Electronic BUsiness LAnguage), a programming language employing ordinary English words, for use with the Ferranti Orion Data Processing System. No previous acquaintance with automatic programming languages is assumed and the account is not a formal one, but most of the basic topics are fully treated. A complete example of the use of the language in a stock control application is given. 3 refs.

2801 **Optimized subroutines.** R. J. Gardner and T. H. Gossling, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 648-649. Letter referring to 'Computer generation of optimized subroutines', H. H. Denman, *ibid,* **8,** Jan. 1961, 104-116 (*C.A.,* **5,** Sept. 1961, Ref. 2000) and briefly describing related work on programming the production of coefficients for polynomial approximations to as wide a range of functions as possible.

2802 **A programmer's look at JOVIAL.** C. J. Shaw, *Datamation,* **7,** Oct. 1961, 46-50. JOVIAL, a procedure-oriented programming language derived from ALGOL 58 and designed by System Development Corporation for programming large, computer-based command/control systems, is described and evaluated. 3 refs.

The following abstracts, Refs. 2803 to 2815, are of the papers presented at the ACM Storage Allocation Symposium, 23-24 June 1961, Princeton, New Jersey, U.S.A.; the papers constitute the major part (pages 416 to 464) of the October, 1961 issue of the *Communications of the ACM.*

2803 **Towards a definition of the storage allocation problem.** *Commun. ACM,* **4,** Oct. 1961, 416. Brief summary of a discussion on the above topic, from which it appeared that the main questions were: how the term algorithm is to be understood and to what extent the determination of the details of the executed program is to be considered a part of storage allocation; how much of the process of implementing these decisions in the form of inserting addresses in coding, setting up transfer instruction sequences, and so on, is to be considered properly a part of storage allocation. Reference is made to two, previously published, opening statements:

a. **Approach to definition of storage allocation.** J. D. Rutledge, *ibid,* **4,** May 1961, 209-210. The author defines storage allocation as the portion of the allocation-compilation operation which is concerned with the distribution of space-taking entities over the machine space-time and with deriving the specific information required to do this. The problem of storage allocation is to find computational methods for doing this in optimal fashion for all computers, of whatever size, and to establish adequate means for communication of information related to this process between the system and the user.

b. **Discussion of the problem of definition of storage allocation.** A. W. Holt, *ibid,* **4,** May 1961, 210-211. The author approaches the definition of storage allocation by considering it as a process having as primary output a table listing specific physical locations by absolute address (whatever that may mean in the context of a given computer), classified by informational object assigned to that location, and the program time at which this assignment is effective. This table must specify a specific assignment for each informational entity at each time.

2804 **Preplanned vs. dynamic storage allocation techniques.** *Commun. ACM,* **4,** Oct. 1961, 416-418. Brief summary of a discussion on the above topic, at which it was generally agreed that preplanned allocation should work best with more regularly predictable problems, whereas dynamic storage allocation can best cope with problems whose flow is highly data dependent and therefore unpredictable. Appended to the summary are the two opening statements:

a. **A preplanned approach to a storage allocating compiler.** R. W. O'Neill, p. 417. The preplanned approach to storage allocation is claimed to provide the best possibilities of achieving an optimum computer program from a source language free of recognition of the storage limitations of the computer, for programs which can be reasonably well flowcharted. Its chief advantage lies in the compiler's ability to integrate the compiling of instructions with the storage allocation problem.

b. **The case for dynamic storage allocation.** B. H. Sams, p. 417-418. The author's advocacy of dynamic storage allocation is based on four points: there is a class of computer applications for which the cost of preplanned storage allocation is unreasonably high; the cost with dynamic storage allocation could be significantly lower for many of these problems; for any class of computer problems, the cost of dynamic storage allocation need not greatly exceed the cost of preplanned storage allocation once the required programming system has been built; significant secondary advantages accrue to the user of a dynamic storage allocation system.

2805 **A general formulation of storage allocation.** A. E. Roberts, *Commun. ACM,* **4,** Oct. 1961, 419-420. This paper attempts to formalise a general computer storage allocation process. With a given computer M is associated a fictitious computer M' essentially identical to M except in respect to unbounded primary storage. Mappings of the total storage set (internal and external) of M into the direct address set of M' are introduced. A program sequence P for M' is termed M-admissible (relative to a specific execution time period) if there is a mapping under which P and its effective data referents are all allocated in the direct address set of M. Storage allocation is considered as a process of establishing for an arbitrary M' program a sequence of mappings, a decoupling of the program into M-admissible subprograms and a linking set of interludes.

2806 **Problems of storage allocation in a multiprocessor multiprogrammed system.** R. J. Maher, *Commun. ACM,* **4,** Oct. 1961, 421-422. This paper describes the main features of the dynamic storage allocation routine included in the automatic programming system for the Burroughs B5000 Information Processing System. 4 refs.

2807 **Program organization and record keeping for dynamic storage allocation.** A. W. Holt, *Commun. ACM,* **4,** Oct. 1961, 422-431. This paper describes features of organisation and record keeping which form part of the design plan of the core allocation portion of the ACSI-MATIC Programming System. Project ACSI-MATIC is concerned with the application of computer techniques to the activities of certain headquarters military intelligence operations of the U.S. Army. (See also Ref. 2808.)

2808 **Dynamic storage allocation for an information retrieval system.** B. H. Sams, *Commun. ACM,* **4,** Oct. 1961, 431-435. This paper is concerned with an information retrieval problem whose programming solution included dynamic storage allocation. Allocatable machine code is defined and an assembly program to produce allocatable machine code is described. The work reported was done as part of Project ACSI-MATIC (see Ref. 2807). The problem was to design a system capable of digesting a large volume of daily input in such a manner as to be able to regurgitate selected portions of information in response to interrogations on a real time basis. 2 refs.

2809 **Dynamic storage allocation in the Atlas computer, including an automatic use of a backing store.** J. A. Fotheringham, *Commun. ACM,* **4,** Oct. 1961, 435-436. This paper is concerned with the method of address interpretation in the Atlas. The address interpretation achieves the effect of dynamic storage allocation throughout the main memory; it also provides for automatic transfers of information, as required, between the core store and a backing store on drums. The core and drum stores can be considered together as a single memory (of maximum size about one million 48-bit words), and addressed as being entirely immediate access. Access is in fact immediate only to the core part of the memory, but internal exchanges between the cores and drums are performed to bring the required information to the core store for use.

2810 **Experience in automatic storage allocation.** G. O. Collins, *Commun. ACM,* **4,** Oct. 1961, 436-440. This paper presents the point of view that in order to solve efficiently some of the extremely complex problems now being considered, it is necessary to have a powerful programming system not only to assist in the preparation of program and data segments but also to supervise and participate in the execution of the program. To achieve the power and flexibility needed, the programming system must provide a facility for complete dynamic allocation of all storage media of the associated computer complex. Some of the interrelationships between storage allocation and other aspects of programming system designs are discussed. The author comments on some storage allocation problems in a programming system currently being designed (for the IBM 7090) and reports on the work done so far towards solving these problems.

2811 **A storage allocation scheme for ALGOL 60.** J. Jensen, P. Mondrup and P. Naur, *Commun. ACM,* **4,** Oct. 1961, 441-445. This paper describes a storage allocation scheme used in the ALGOL system for DASK, the Regnecentralen, Copenhagen computer which has a 2048-instruction store and a magnetic drum. The use of the drum for storing program blocks and/or data must be directed by the programmer through auxiliary information in the ALGOL program. The administrative routines controlling the storage at run time are described in full. A detailed example is given. 3 refs.

2812 **A semi-automatic storage allocation system at loading time.** W. P. Heising and R. A. Larner, *Commun. ACM,* **4,** Oct. 1961, 446-449. This paper describes a method of storage allocation involving memory overlay, developed as a result of experience with the IBM 704, 709 and 7090 FORTRAN systems.

2813 **Techniques for storage allocation algorithms.** J. E. Kelley, *Commun. ACM,* **4,** Oct. 1961, 449-454. This paper discusses in an informal manner the application to storage allocation problems of such techniques as integer linear programming, dynamic programming, heuristic methods, and graph and network flow theory. 25 refs.

2814 **Core allocation based on probability.** B. N. Riskin, *Commun. ACM,* **4,** Oct. 1961, 454-459. This paper discusses a method of core allocation proposed for use in a large scale, real time, man-machine, data processing and display system. In this system, data is acquired from several input sources by means of an executive program which successively samples input stations. In addition, the executive program periodically retrieves data from the computer mass storage media by reference to a real time clock. On the basis of a cursory examination of the input datum, an operational program is selected by the executive and called into the core from the drum. The operational program processes the datum and determines which one of other operational programs should succeed itself. This process is repeated through several programs until the datum is completely processed and control is returned to the executive. The major objective of the core allocation method described is the minimisation of drum-to-core transfer time for programs and fixed tables and the method is based on the concept that the most frequently used programs and fixed-size tables should be assigned the most favourable positions in core memory. Allocation is performed only when new programs or tables are added to the system and is made so that the probability of given entities of information being already in core when required is a function of the frequency with which those entities will be required. (See also Ref. 2815.)

2815 **Stochastic evaluation of a static storage allocation.** L. J. Cohen, *Commun. ACM,* **4,** Oct. 1961, 460-464. This paper is concerned with the allocation technique described in Ref. 2814, and develops an objective rule of evaluation of the efficiency of a specific allocation of a given library of programs and data. 4 refs.

See also:—
Design: Ref. 2649.

APPLICATIONS

AERO- AND ASTRONAUTICAL

2816 **Design and development of a sampled-data simulator.** J. E. Reich and J. J. Perez, *Proc. Western Joint Computer Conference,* 1961, 341-351. This paper describes the design and development of a sampled-data simulator (a special purpose analogue computer) constructed at Space Technology Laboratories Inc. The machine, developed to simulate missile and spacecraft control system problems containing both continuous and sampled information, has increased the speed of simulation and decreased operating costs. The sampled data channel consists of two zero-hold circuits in cascade, the first amplifier sampling the continuous input signal and the second amplifier presenting the stored information. Performance accuracy, which is within 0.01% of the desired value, was achieved by employing the special design and packaging techniques which are described. 6 refs.

2817 **X-15 analog flight simulation program—systems development and pilot training.** N. R. Cooper, *Proc. Western Joint Computer Conference,* 1961, 623-638. Flight simulation has been used in all design and testing phases in the development of the X-15 Research Vehicle: first to support the configuration and subsystem design; next to test and evaluate subsystems, displays and control hardware, both in prototype and final production form; and finally to provide flight test support and pilot training. This paper reviews briefly the overall simulation programme conducted during the 5-year development of the X-15 and describes in detail the unrestricted six-degree-of-freedom mechanisation which has been utilised during the past three years. The most important of the many applications in which the simulator has been used in design, development and flight testing are described.

2818 **Development of a computer subroutine for planetary and lunar positions.** H. F. Michielsen and M. A. Krop, Lockheed Aircraft Corp., *AD-260324,* May 1961, 26 p., $0.75. An attempt is made to reduce the time required in computing planetary and lunar positions data, and to improve the program where possible. An option was evolved which allows the omission of the determination of the Moon's velocity at a considerable saving in computer time.

2819 **Dynamic stability analysis of a VTOL vectored slipstream vehicle during transition.** G. A. Williamson, Princeton University, *AD-260719,* April 1961, 90 p., $8.10. The six equations of motion appropriate for the vectored slipstream aircraft during transition are developed and examined numerically on the LGP-30. The characteristic roots of these equations are calculated and presented as a function of forward velocity during typical transition manoeuvres.

2820 **Ground effect on airfoils. Rheoelectric analog study of theoretical flows.** L. Malavard, Bureau d'Analyse et de Recherche Appliquees, France, *AD-261332,* April 1961, 61 p., $6.60. Two-dimensional flows around wing airfoils placed in the immediate vicinity of the ground were analysed theoretically and by means of the rheoelectric analogue with which an exact solution can be obtained. Different methods are described, which make it possible to simulate in an electric tank either the velocity potential or the stream function, or the argument-function, or the logarithmic potential of the flow. Applications to convex-plane airfoils, Clark-Y airfoils with or without blowing, and flat plates with flaps, are indicated. 12 refs.

2821 **An orbit computer for a satellite position display.** H. G. Talmadge, Naval Research Lab., Washington, *AD-261475,* 31 July 1961, 39 p., $1.00. A display suitable for presenting earth satellite information on shipboard is being investigated. This study investigates the computational phase of the problem. A combination of digital and analogue techniques, with servo amplifiers to position the shafts of magnetic resolvers which generate sine and cosine functions, is proposed to implement equations derived for the calculation of satellite height and of subsatellite position as latitude and longitude. Orbital elements and initial conditions are selected for up to ten satellites out of the total in a digital store, and positions are computed for each in turn at any arbitrary time. Computer output appears in digital form and, depending upon display design, may be either placed in a register or displayed directly. Essentially continuous orbits can be computed as a succession of subsatellite positions corresponding to small discrete increments in time through an anomalistic period bracketing the selected epoch. According to display design, the resulting subsatellite track will be either displayed directly or stored in a scan-converter cathode-ray tube.

See also:—
Electronics: Ref. 2839.
Simulation: Refs. 2868*b* and *e*.

BUSINESS

2822 **Coding business data.** G. Myers, *Data Processing (Detroit)*, **3,** Oct. 1961, 23-25. The factors to be considered in designing an efficient code for business data are discussed and five basic types of code are outlined.

2823 **Computer-based management control.** A. J. Rowe, *Proc. Western Joint Computer Conference,* 1961, 587-592. This paper considers generally the requirements of management control systems and the factors to be taken into account in designing computer-based systems.

2824 **Computer control in the shoe industry.** *Data Processing (London),* **3,** Oct.-Dec. 1961, 232-239. A general account is given of the system, employing two IBM 305 RAMAC computers, used by C. and J. Clark Limited (shoe manufacturers) to control stocks, order schedules and production requirements. Detailed records of shoes on order and in course of production are continuously up-dated. In a series of inter-related operations, invoices, statements and sales statistics are produced.

2825 **Einsatzmöglichkeiten elektronischer Rechenanlagen für die Marktforschung.** (Possibilities for the application of electronic computers in market research.) K.-F. Schopper, *Elektronische Datenverarbeitung,* No. 5, 1961, 212-219. (In German.) This paper reviews the use of computers for market research applications. 12 refs.

2826 **Management games and computers.** J. M. Kibbee, *Proc. Western Joint Computer Conference,* 1961, 11-16. This paper discusses management games with the object of arousing interest in them as a computer application. After a brief description of the Remington Rand Univac Marketing Management Simulation as a typical game, the differences between various kinds of games are indicated. Manual and computer games are then compared and the educational advantages of management games are discussed. Various factors to be considered in the construction of a management game are described and, finally, the future of management games is briefly examined.

2827 **New systems for a new HQ.** K. Bean, *Auto. Data Processing,* **3,** Oct. 1961, 25-28. A brief, very general account of the use by Dorothy Perkins Limited of a De La Rue Bull Gamma 3 system for control of stock including allocations of stock to branches.

2828 **An on-line management system using English language.** A. Vazsonyi, *Proc. Western Joint Computer Conference,* 1961, 17-37. This paper presents a demonstration model of an on-line management system which aims to provide increased management capability to executives charged with planning and control of large scale research, development and production programmes. The technique is formulated as an exercise in decision gaming with special emphasis on the problem of providing capability for quick and optimum reprogramming of dollars, manpower, facilities and other resources. The task of planning and control is structured into two components, the more routine tasks are assigned to the equipment, whereas problems requiring executive judgement are delegated to players of the decision game. Through the use of mathematical models and computer routines the consequences of proposed reprogramming actions are presented to the players in terms of financial and manpower requirements, etc. Through a step-by-step man-machine process, optimum programmes and the best utilisation of resources is reached. Management data is retrieved and manipulated on an on-line basis and all operations of the equipment are executed through everyday English commands. All data is displayed on cathode ray tubes and projection screens and input is by means of keyboards. 6 refs.

2829 **PERT.** V. B. Thompson, *Data Processing (Detroit),* **3,** Oct. 1961, 40-42, 44. PERT (Program Evaluation and Review Technique) is briefly outlined and its value is discussed.

2830 **Real-time management control at the Hughes Aircraft Company.** D. R. Pardee, *Proc. Western Joint Computer Conference,* 1961, 603-607. The author suggests that a new approach is needed in meeting management information requirements, and criticises the old approach—exemplified by batch processing, maintenance of voluminous card and tape files, and rigidly structured reports. Information systems must provide more visibility and responsiveness and must be more flexible and contain more economy of operation than traditional techniques afford. The application at Hughes Aircraft Company of automatic data collection, large random access files and report generator programs is briefly discussed and an inventory control system is outlined to illustrate their use. 7 refs.

See also:—
Programming: Ref. 2800.

CHEMICAL

2831 **Calculation of thermogravimetric data by electronic digital computer.** J. R. Soulen, Pennsalt Chemicals Corp., *AD-260047,* July 1961, 7 p., $1.10. A method has been developed for automatic computation of temperature, weight, weight loss, and rate of weight loss from raw electromotive force data representing these quantities in thermogravimetry.

CONTROL—GENERAL SYSTEMS

2832 **Stability analysis of two-parameter control systems.** M. L. Shooman, Polytechnic Inst. of Brooklyn, *AD-260044,* June 1961, 105 p., $9.10. This report treats the problem of stability in 2-parameter control systems and includes, *inter alia,* a discussion of analogue computer methods that allow experimental location of stability and performance boundaries in complex problems.

CONTROL—PRODUCTION AND PROCESS

2833 **Input-output techniques in computer process control.** P. G. Corrin, *Control,* **4,** Oct. 1961, 89-93. This article is concerned with input-output arrangements for a digital computer employed in process control and discusses such topics as types of input and output, address decoding, switches (relay, diode, transistor), analogue-to-digital conversion, conversion of the cyclic progressive code of digitiser outputs to normal binary, and output storage.

ELECTRONICS

2834 **Monte Carlo analysis of transistor diffusion techniques.** D. P. Kennedy, *IBM J. Res. & Dev.,* **5,** Oct. 1961, 331-334. This letter concerns an analytical approach to the problem of base-width reproducibility in the construction of double-diffused transistors. To investigate the influence of diffusion tolerances, Monte Carlo methods of statistical analysis are applied to an elementary equation characterising the impurity distribution within a transistor. From large statistical samples, base-width distribution diagrams are presented which illustrate the simultaneous influence of experimental tolerances for five parameters of the diffusion process. The investigation was conducted on the IBM 7090. With the aid of a number generator having suitable statistical properties, independent variables within the impurity distribution equation were varied throughout a range representing their individual experimental tolerances. 5 refs.

2835 **Optimization of a radar in its environment by GEESE techniques.** E. L. Berger and R. M. Taylor, *Proc. Western Joint Computer Conference,* 1961, 491-506. One of the most complex problems in optimisation of ground radars is the evaluation of the ground clutter and how it influences the operation of the radar. A fundamental limitation of ground radars is that the radar is unable to distinguish stationary targets in the presence of large amounts of random scatterers. This paper describes how the capability of a phase comparison radar to pick the stationary targets out of random scatterers has been evaluated on the analogue computer GEESE (General Electric Electronic Systems Evaluator). A model of Frankford Arsenal's radar was built on GEESE and tested in single and multiple target situations in an environment consisting of random scatterers (clutter). This was accomplished by simulating mathematical characteristics of ground clutter and applying this as an input to the simulated model. 5 refs.

2836 **Computer simulation of the pure-phase periodogram and the Doppler phase difference integrator.** S. F. Catalano and E. J. Jones, M.I.T., *AD-261365,* 12 Sept. 1958. 8 p., $1.10.

2837 **Patterns of dishes with multiple feeds.** A. F. Kay, Technical Research Group, *AD-261287*, 13 June 1961, 55 p., $2.60. In certain applications it is desirable to form multiple radar beams with the same reflector by means of multiple feeds. The wide angle ability of paraboloids is very limited so that the beams of feeds off-axis have higher side lobes and lower gain. In some applications one may wish to transmit through all feeds simultaneously, producing one broad beam, and receive separately a narrow beam with each feed. The narrow beams together generate the broad beam and the information they contain constitutes a crude radar picture. The flexibility and increased range of separate transmitters and/or receivers is another feature of this type of system. In order to investigate specific cases, a program was written which computed the far field pattern of a circular paraboloid reflector with a finite collection of sources at or near the focus. In the special case, of a single source, the pattern of an off-axis source or defocussed source was obtained.

2838 **SIMRAR. Simulated Receiver and Recorder for statistical measurements.** D. W. Fife, University of Michigan, *AD-260707*, Jan. 1961, 80 p., $8.10. SIMRAR (SIMulated Receiver And Recorder) is a special purpose analogue simulator, incorporating circuits for statistical measurements and recording. The equipment was designed and built for use in experimental studies of receiving systems for the detection of signals in noise. The equipment is used for statistical studies of signal detection by receivers employing fixed observation time, or sequential decision processes. Considerable versatility in simulation is provided through the use of operational amplifiers, a function generator, and the general switching circuits included in the equipment.

2839 **Specification for West Ford pointing program.** F. E. Heart, M.I.T., *AD-261181*, 20 July 1961, 13 p., $1.60. A system of computer programs was implemented to support the West Ford project. A general diagram of these programs is given. A particular program of that system is described which is called pointing program. The program accepts as input, the following information (in punched card form): (1) orbit parameters (defined for a particular time period); (2) site selections (one or more of a small number of predetermined ground sites); (3) schedule selection(s) (for example a schedule directing two antennas to a common volume on the belt which gives rise to minimum distance sum). The program computes pointing angles (azimuth and elevation) and predicted range for all the selected sites, for each selected schedule, for approximately a six-hour period at intervals of five seconds or one-half second.

2840 **Study of I-F transformers for single sideband operation.** G. I. Cohn and E. W. Weber, Ilinois Inst. of Technology, *AD-260054*, 30 April 1961, 55 p., $5.60. This report concerns the study and development of precision RF filters. An approach to network synthesis that differs from the conventional low pass-band pass transformation method is presented. The approach is to determine a circuit configuration known to be capable of producing a suitable approximation to the desired response. This network determines the nature of the rational function transfer function. An approximation method is presented which determines the coefficients of this rational function. From these coefficients, the element values of the network are determined. The entire design procedure can be programmed on a digital computer. The approximation method is presented in detail.

2841 **A variational method of synthesizing antenna power patterns.** E. K. Proctor and C. M. Ablow, Stanford Research Inst., *AD-260244*, March 1961, 51 p., $6.60. A variational approach is developed by means of which both the phase and the amplitude of an antenna excitation function that approximates a prescribed far-field power pattern can be determined. No information concerning the phase of the prescribed pattern need be supplied. The resultant pattern will be an optimum approximation in a mean-square sense and the excitation function will be the smoothest one possible under the prescribed circumstances. A numerical procedure whereby the necessary computation can be performed on a digital computer of only moderate speed and capacity is described.

ENGINEERING, ELECTRICAL

2842 **The determination of electromagnetic forces in transformer windings with axial symmetry by means of a resistance network.** H. Goldenberg, *Ann. Assn. Int. Calcul Analogique*, **3,** Oct. 1961, 164-166. In this paper, it is shown that the electromagnetic forces in transformer windings with axial symmetry can be determined by means of a two-dimensional resistance analogue procedure based on a finite difference approximation of the basic differential equations and boundary conditions. 5 refs.

INFORMATION RETRIEVAL

2843 **Automating IR input.** P. L. Garvin, *Datamation*, **7,** Oct. 1961, 29-30. This article discusses the progress in such areas as speech recognition, character recognition, automatic indexing and automatic abstracting.

2844 **Baseball: an automatic question-answerer.** B. F. Green, A. K. Wolf, C. Chomsky and K. Laughery, *Proc. Western Joint Computer Conference*, 1961, 219-224. This paper appears to be the same as the report *AD-257778* (*C.A.*, **5,** Oct. 1961, Ref. 2336).

2845 **Compromise—a key to documentation.** A. Kent and G. Barhydt, *Datamation*, **7,** Oct. 1961, 26-28. This article relates to information retrieval studies at Western Reserve University and discusses the 'human side' of information retrieval and the numerous compromises necessitated by it.

2846 **Correspondence.** R. A. Fairthorne, *Computer J.*, **4,** Oct. 1961, 216, A letter re-asserting the writer's criticisms of the paper 'Prime number coding for information retrieval', A. H. Cockayne and E. Hyde, *ibid*, **3,** April 1960, 21-22 (*C.A.*, **4,** June 1960, Ref. 1052), originally made in a letter, *ibid*, **4,** April 1961, 85 (*C.A.*, **5,** June 1961, Ref. 1309) and which were refuted in a letter from C. R. Merton, *ibid*, **4,** July 1961, 120 (*C.A.*, **5,** Oct. 1961, Ref. 2335).

2847 **Information retrieval: state of the art.** D. R. Swanson, *Proc. Western Joint Computer Conference*, 1961, 239-246. This paper first examines certain aspects of science communication which are of especial importance to information retrieval. Questions related to increasing specialisation raised by the exponential growth of scientific information are indicated. The tendency not to use information retrieval systems is considered and 'quality identification' rather than 'quality control' is suggested as an aid in discriminating between important and unimportant literature. The common set of basic problem areas and solutions shared by all approaches to information retrieval are then discussed. Semantics and redundancy are key conceptual issues and give rise to difficulties more likely to be overcome by meticulous thesaurus compilation than by any sudden insight or breakthrough. The effectiveness of present retrieval systems is considered. Presentation and display to the user are suggested as important approaches to problems of information digestibility. 22 refs.

2848 **Information retrieval—1961.** E. Miller, *Datamation*, **7,** Oct. 1961, 19-21. General discussion of the status of information retrieval research.

2849 **Information retrieval—1966.** B. F. Cheydleur, *Datamation*, **7,** Oct. 1961, 21-25. The author discusses various problems to be solved in the information retrieval field and the possibilities of solving them in the next five years. Topics discussed include economic prospects, inputs and displays, automatic text transcription, automatic indexing and abstracting, associative memory, memory capacity, and communication linkages. 18 refs.

2850 **A screening method for large information retrieval systems.** R. T. Moore, *Proc. Western Joint Computer Conference*, 1961, 259-274. This paper presents proposals for reducing the excessive processing times sometimes encountered in large information retrieval systems. Two basic ideas are suggested: a screening system to allow multi-level processing of material; and pre-processing of the files to allow block rejection of documents not answering a retrieval request. A screen using descriptors to constitute the first level of screening is described in detail and a pre-processing technique, based upon clustering of descriptors, is developed. Two methods of implementation on high speed data processors are described based on serial access type storage and random access dynamic storage respectively. This screening technique is compared for efficiency against two other methods of employing descriptors: the ordinary serial descriptor list method and the inverted file technique. 12 refs.

2851 **Semantic road maps for literature searchers.** L. B. Doyle, *J. Assn. Computing Mchy.*, **8,** Oct. 1961, 553-578. This paper suggests that natural characterisation and organisation of information can come from analysis of frequencies and distributions of words in libraries. An information retrieval system is proposed in outline, in which a searcher would be presented on a display console with 'maps' of words with various association links between them to assist him in selecting relevant documents. 11 refs.

2852 **Technical information flow patterns.** M. M. Kessler, *Proc. Western Joint Computer Conference,* 1961, 247-257. This paper presents the results of a study of the flow of scientific information from originator to consumer and discusses the application of these results in the design of an information retrieval system. A study of the bibliographies of a large number of articles in physics and electrical engineering indicated that definite patterns exist for the flow of technical information. Quantitative data are given on the flow of information across political boundaries, from a basic science to an applied technology, and from past to present. The efficiency of various journals as carriers of information is discussed. 1 ref. (See also Ref. 2853.)

2853 **Technical information flow patterns.** M. M. Kessler, M.I.T., *AD-261303,* 1961, 11 p., $1.10. This report appears to be the same as the paper abstracted in Ref. 2852.

MECHANICAL TRANSLATION

2854 **Progress in automatic language translation.** A. D. Booth, *Control,* **4,** Oct. 1961, 103-105; Nov. 1961, 103-105. After a brief historical account of the development of mechanical translation, the papers given at the International Conference on Machine Translation of Languages and Applied Language Analysis, National Physical Laboratory, 5-8 September, 1961, are reviewed.

2855 **Machine language translation study.** E. D. Pendergraft, Texas University, *AD-260254,* 30 April 1961, 73 p., $7.60. Two years of research by the Machine Language Translation Study at the University of Texas are summarised. The mathematical basis of a generalised computer system for language translation is explained as a series of three models. The general models can be interpreted both linguistically to obtain grammars of specific languages, and operationally to obtain translation algorithms in a wide range of complexity and competence. The current status of mathematical, programming and linguistic research is given.

MEDICAL

2856 **The CELLSCAN system—a leucocyte pattern analyzer.** K. Preston, *Proc. Western Joint Computer Conference,* 1961, 173-183. Medical workers suspect that the incidence of the binucleate lymphocyte in the peripheral blood stream is an index of radiation damage. The fact that the incidence of this type of white cell is of the order of one per each million blood cells makes practical use of this index by the human observer essentially impossible. This paper describes an experimental blood cell scanning system which has been constructed for the U.S. Atomic Energy Commission in order to determine the feasibility of using electro-optical scanning and pattern recognition techniques to identify the binucleate lymphocyte in glass-mounted smears of human blood. The CELLSCAN system consists of a closed circuit television microscope coupled to a special purpose digital computer. The system produces a quantised image of the leucocyte whose pattern is to be analysed. The computer program causes the quantised image to be operated on serially in such a way that groupings of contiguous binary 'ones' are reduced to single 'ones'. Sampling the number of isolated 'ones' at various instants during the reduction process produces a histogram of the leucocyte's various constituent parts. 7 refs.

MILITARY

2857 **The use of manned simulation in the design of an operational control system.** M. A. Geisler and W. A. Steger, *Proc. Western Joint Computer Conference,* 1961, 51-62. The general features of the planning and operations phases of a new weapon system are described. The uncertainties inevitable in planning mean that considerable effort is made during the operations phase to adjust the weapon system and its resources to the actual environment it finds so as to attain the desired level of operational capability. The adjustment mechanism is called an operational control system and the elements of such a system are described. It is suggested that a better control system can be designed if simulation is used to help design it during the planning phase. An example of such a study at the Rand Corporation Logistics Systems Laboratory is described. Use was made of an IBM 704 and IBM 305 RAMAC in the design and evaluation of a control system for an ICBM weapon system of the 1963-1965 period.

See also:—
Aero- and Astronautical: Ref. 2816.
Simulation: Ref. 2867.

NUCLEAR

2858 **An improved eigenvalue corrector formula for solving the Schrodinger equation for central fields.** J. W. Cooley, *Maths. of Computation,* **15,** Oct. 1961, 363-374. This paper relates to an investigation concerned with obtaining an accurate method for calculating the nuclear wave functions and vibrational-rotational energies of diatomic molecules with some economy in the number of values of the internuclear potential required. An improved formula for the correction of trial eigenvalues, which does not depend so much for its accuracy upon the smallness of the step-size in the radial coordinate, and an analysis of the convergence of the procedure are given. Numerical results obtained from a computer subroutine, for a case where exact analytical solutions are known, are described. 8 refs.

2859 **FANTASIA and TRIPROD—shielding codes for the 1103A Univac.** H. Steinberg, J. Heitner and R. Aronson, Technical Research Group, *AD-249258 (PB 171945),* Sept. 1960, 111 p., $2.50. Two codes were developed for the 1103A Univac. FANTASIA computes neutron tranmission through laminated slab shields and slowing down density within the shields by Monte Carlo methods. TRIPROD is a slowing down code suitable for shielding problems. It is based on the General Electric reactor code VALPROD. Both theory and application of FANTASIA and TRIPROD are discussed. Operating instructions are included. 3 refs.

2860 **HECTIC: an IBM 704 computer program for heat transfer analysis of gas-cooled reactors.** W. C. Reynolds, D. W. Thompson and C. R. Fisher, Aerojet-General Nucleonics, *AGN-TM-831,* May 1961, 60 p., $1.25.

2861 **Multigroup transport code RDR 5.** C. Dawson, David Taylor Model Basin, *PB 157209,* Dec. 1960, 25 p., $2.60. RDR 5 is a multigroup, slab geometry neutron transport code for NORC. With features such as anisotropic scattering, as many as 99 lethargy groups, and a 10-point discrete ordinate approximation to the angular dependence of the vector flux, the code can provide solutions with considerable accuracy. The equations used in the code are derived and the input for the code is described. The results obtained with different approximations that may be used in RDR 5 are compared. 5 refs.

2862 **Results obtained using an IBM 704 program for computing U^{235} fission-product populations, activities and powers.** T. B. Kerr and R. B. Walton, Kirtland AFB, *AD-229037 (PB 157694),* Aug. 1959 (Released to public 8 Sept. 1961), 67 p., $6.60. The theory, flow diagrams, decay chain assignments, and operating instructions for an IBM 704 program for calculating the fission product inventories for U^{235} fueled reactors are presented. Comparisons of U^{235} fission product decay power and activity between this program and the Way-Wigner equation for cyclic operation are made for a number of cyclic reactor histories. A graph is presented showing the ratio of the gamma power from each of four arbitrarily chosen energy ranges to the total gamma power as a function of time after 10^{23} fission. The ratio of fission-product beta power to gamma power for several histories is also graphically presented. Gross fission product properties and the individual isotopic activities after 21 cycles are listed. 10 refs.

2863 **The transmission of monoenergetic neutrons through polyethylene. Machine calculations.** F. J. Allen, A. Flutterer et al., Ballistic Research Labs., Aberdeen Proving Grounds, *AD-261065,* April 1961, 211 p., $14.00. Detailed results of calculations of the transport of monoenergetic neutrons through plane, laterally infinite, slabs of polyethylene containing eight per cent boron carbide by weight are given. The results consist of machine printouts and are in tabular form. Less extensive results are given for pure polyethylene. The calculations were made by the Monte Carlo method. Sufficient descriptive material is presented so that the printouts can be understood.

See also:—
Mathematics: Ref. 2712.
Medical: Ref. 2856.

PHYSICS

2864 **Analog computer simulation of heat transfer to a moving fluid.** D. E. Fletchall, Atomics International, *NAA-SR-M-6328,* 19 April 1961, 32 p., $1.16.

2865 **Computations for the excluded volume problem in connection with the conformation of polymer molecules.** M. P. O'Flaherty, Stanford University, *AD-260061*, 3 July 1961, 38 p., $3.60. An IBM 7090 program was developed to verify certain results and contribute to the excluded volume problem. The distribution of the mean square length of all possible walks of n steps was computed for walks of up to and including 16 steps in the 2-dimensional, 90°, 3-choice lattice. The values of u_n non-intersecting closed walks of n steps were also computed.

2866 **Transformation of observed projected intensities into radial distribution of the emission of a plasma.** K. Bockasten, Uppsala University, Sweden, *AD-260199*, 4 July 1960, 8 p., $1.60. A new method for transforming observed projected intensities into the radial distribution of the emission is described. It is applicable to optically thin plasmas with cylindrical or spherical symmetry, which are often encountered in plasma physics and astrophysics. The observations are introduced as a sequence of n readings on the experimental curve, which are then transformed to a set of values for the emission coefficient. The transformation coefficients are tabulated for $n=10$, $n=20$, and, in part, for $n=40$. The method is more accurate and more direct than previously published ones and is well suited for rapid calculating by electronic computers. The sources of errors are discussed and a numerical method for smoothing the readings is suggested.

SIMULATION

2867 **Analog-digital hybrid computers in simulation with humans and hardware.** O. F. Thomas, *Proc. Western Joint Computer Conference*, 1961, 639-644. The U.S. Naval Ordnance Test Station, Pasadena, operates an analogue simulation centre for testing antisubmarine torpedoes and the associated fire control equipment. This simulation incorporates a real torpedo on a flight table, a real fire control computer and real fire control personnel. The simulation must be run in real time in order to place the proper requirements on the components being tested; for example, the human operators must not be allowed any extra decision-making time. It is now intended to incorporate a digital computer into the simulation and this paper considers the general system—an analogue-digital hybrid computer required to work in real time with humans and hardware. Certain problem areas are defined and some techniques of solution are presented.

2868 **Simulation Council Newsletter.** J. McLeod (Ed.), *Instr. & Control Systems*, **34,** Oct. 1961, 1883, 1884, 1886, 1888, 1889, 1891-1893. The main items are as follows:

a. **Midwestern Simulation Council meeting of 15 May on Education.** L. M. Warshawsky; A. I. Katz; W. B. Field; R. J. King; R. M. Howe, p. 1883, 1884, 1886, 1888. Five talks dealing with the subject of training in analogue computers and computation.

b. **A free turbine engine for helicopter applications.** G. Brown, p. 1888. Talk on helicopter control system simulation.

c. **The simulation of static and frictional forces.** J. Zampino, p. 1888-1889. Discussion of simulation of frictional forces under various conditions.

d. **Determination of true input.** M. S. Mason, p. 1889. Talk on implicit function techniques useful for analogue data reduction.

e. **Analog techniques—pulse circuit.** T. C. Anderson, p. 1889, 1891. Description of a pulse circuit designed for marking time on an altitude-distance plot concerned in a trajectory study. In addition, the circuit produces square and triangular waves.

(Items *b* to *d* are very brief summaries of talks given at the Rocky Mountain Simulation Council meeting of 27 June 1961.)

2869 **Simulation: a survey.** H. H. Harman, *Proc. Western Joint Computer Conference*, 1961, 1-9. This paper examines the scope of digital simulation and reviews current activities in this field. After discussing various definitions of simulation, the author suggests that the simplest and most direct definition may be: 'the act of representing some aspects of the real world by numbers or other symbols that can be easily manipulated.' The classification of different types of simulation is then considered. Advantages of simulation as a research tool are outlined. The paper concludes with a review of simulation activities under the headings: operational gaming, management control, social behaviour, vehicular traffic, and simulation in man-machine laboratory research. 20 refs.

TRANSPORT

2870 **American Airlines' "Sabre" electronic reservations system.** W. R. Plugge and M. N. Perry, *Proc. Western Joint Computer Conference*, 1961, 593-602. This paper gives an account of the Sabre reservation system, a joint development of American Airlines and IBM, employing two IBM 7090 computers, and of the functions it will perform in the areas of passenger sales, reservations record service and management reporting.

2871 **Application of digital simulation techniques to highway design problems.** A. Glickstein and S. L. Levy. *Proc. Western Joint Computer Conference*, 1961, 39-50. This paper gives an account of the digital simulation of traffic flow as an aid to highway design, using an IBM 704 at the Midwest Research Institute, Kansas City, Missouri, U.S.A. A study of the operating characteristics of the driver-vehicle combination yielded a simulation model which can duplicate traffic flow on a 17,000-ft. section of a freeway including two on-ramps and two off-ramps. The simulated vehicle in the model, following decision rules based on actual traffic behaviour is allowed to manoeuvre through the section of freeway under study. The effects of changes in traffic volume, traffic velocity, freeway configuration, etc., can be evaluated by noting changes in the computer output of traverse time, waiting time on ramp, volume-velocity relationship, weaving complexity, etc. 19 refs.

2872 **Checking-in 2,000 passengers an hour.** *Data Processing (London)*, **3,** Oct.-Dec. 1961, 220-231. A general account is given of a specially designed system, employing a Stantec Zebra, used by Scandinavian Airlines System at Kastrup Airport, Copenhagen, to check passengers on to flights and to confirm that aircraft are correctly loaded before they are cleared for take-off. Data about passengers and their luggage are entered on keysets at reception desks. Signal lights on the keysets indicate whether a passenger can be accepted on a flight or not, or whether he can be placed on a waiting list. At the same time, information about freight and fuel being loaded on to the various aircraft is entered on master keysets situated in the airport weight and balance control office. All the keysets are connected by cable to the computer which up-dates the records of the loading status of as many as 60 aircraft, prints warning reports specifying the nature and amount of any overloads, and, just before a flight is due to leave, produces a final loading statement.

MISCELLANEOUS

2873 **Analog simulation of underground water flow in the Los Angeles Coastal Plain.** D. A. Darms and H. N. Tyson, *Proc. Western Joint Computer Conference*, 1961, 535-543. This paper presents a general purpose analogue computer approach to the study of the underground water flow in the Los Angeles Coastal Plain. The study was undertaken in connection with plans to inject water into the basin to combat water shortages. The structure of the Los Angeles basin aquifer system is discussed. A suitably simplified model of the aquifer system is proposed leading to the diffusion equation in two dimensions. The diffusion equation model is approximated by a system of difference-differential equations defined at a set of asymmetrically spaced node points. An electronic differential analyser circuit is chosen which retains a one-to-one correspondence, in certain of its features, to the asymmetric network approximation. Some special checking techniques are discussed. 1 ref.

2874 **The computer simulation of a colonial socio-economic system.** W. D. Howard, *Proc. Western Joint Computer Conference*, 1961, 613-622. The author suggests that the international political world might be viewed as a system of nations, each described by a unique transfer function. Existing system engineering methods and computer techniques might be applied to this multi-variable system with the hope that a better understanding might be achieved for the rise of international problems and their subsequent solution. An account is given of the design, and actual demonstration, by analogue computer techniques of a colonial socio-economic system which includes national growth and national behaviour models. The national growth model includes such variables as resource, opportunity and incentive with the hopes of evaluating the asymptotic behaviour of the total population. The national behaviour model describes which one of the two political alternatives will be advocated by elements of the organised native class based on the environment defined by the growth model. 13 refs.

2875 **The fairing of ship lines on a high-speed computer.** F. Theilheimer and W. Starkweather, *Maths. of Computation,* **15,** Oct. 1961, 338-355. This paper presents methods for using a digital computer to determine ship lines. It is assumed that the offsets of a small number of points were taken from a preliminary design and that it is desired to compute the offsets of an arbitrarily large number of points on the ship's surface. Procedures for using a computer for the solution of this problem are described. Special emphasis is placed on the detection, by a computational criterion, of unwanted fluctuations and the correction of such fluctuations if they should occur. The method also includes a special procedure which takes care that those portions which are straight in the preliminary design remain straight in the final form. The solution of two particular problems on the IBM 704 is discussed. 5 refs.

2876 **Programmed learning and the use of teaching machines—a revolution in industrial training.** R. L. Chapman, *Computers & Automn.,* **10,** Oct. 1961, 21-23. A general discussion of programmed learning and teaching machines and future possibilities.

2877 **A study of methods for systematically abbreviating English words and names.** C. P. Bourne and D. F. Ford, *J. Assn. Computing Mchy.,* **8,** Oct. 1961, 538-552. This paper reports an investigation of various techniques for systematically abbreviating English words and names. Most attention is paid to techniques which could be mechanised with a digital device such as a general purpose digital computer. Particular attention is paid to techniques that can process incoming information without prior knowledge of its existence (i.e., no table lookups). Thirteen basic techniques and their modifications are described. Most of the techniques were tested on a sample of several thousand subject words and several thousand proper names in order to provide a quantitative measure of comparison. 38 refs.

2878 **Analytical aerial triangulation error analysis and application of compensating equations to the General Block Triangulation and Adjustment Program.** C. L. Miller and E. P. Gladding, M.I.T., *AD-261184,* 10 April 1961, 38 p., $4.60. The results are given of an evaluation study of pertinent and significant information relative to errors, systematic and random, their source, effect, and treatment for the general problem of block analytical photogrammetric aerial triangulation. The particular error sources reviewed are lens distortion, camera parameters, resolution, atmospheric refraction, and film distortion. A discussion of error sources and their treatment, as applicable to the analytical photogrammetric problem, is included. The facility for weighting in the IBM 704 General Block Triangulation and Adjustment Program as supplied by the Government is described. The nature of the weighting routines to be added are described. The converted IBM 709 program is discussed. The salient characteristics, particularly as they differ from the 704 program, and the results of test runs are presented. 35 refs.

2879 **The calculation of specific volume anomalies and interpolation for dynamic heights with the Recomp II computer.** D. A. McGill, Woods Hole Oceanographic Institution, *AD-261227,* July 1961, 25 p., $2.60. Contents: A review of the theory for determination of gradient currents and mass transport in sea water; Recomp II computer program for specific volume anomaly; Comparison of manual and tabular computations of specific volume anomaly with the results of Recomp II; Interpolation and use of specific volume anomaly; Recomp II computer program for interpolation to standard depths and calculation of dynamic heights; Analysis of the results of dynamic computation by Recomp II; Further use of the dynamic height data.

BOOKS

2880 **Proceedings of the Western Joint Computer Conference,** 1961, ix+661 pages, $4.00. Contains the papers presented at the Joint IRE-AIEE-ACM Computer Conference, Los Angeles, California, 9-11 May 1961. The papers are grouped under the following session headings and are individually abstracted in this issue of *Computer Abstracts* under the reference numbers given:

1. Digital simulation: Refs. 2826, 2828, 2857, 2869 and 2871.
2. Microsystem electronics: Refs. 2647, 2648, 2655 and 2657.
3. Modeling human mental processes: Refs. 2679, 2683, 2685 and 2686.
4. Recent advances in computer circuits: Refs. 2641, 2653, 2762 and 2856.
5. Problem solving and learning machines: Refs. 2674, 2675 and 2844.
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7. Automata theory and neural models: Refs. 2673, 2687 and 2691.
8. New hybrid analog-digital techniques: Refs. 2744, 2753, 2778 and 2816.
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10. Automatic programming: Refs. 2649, 2789, 2792, 2794, 2796 and 2799.
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13. Pattern recognition: Refs. 2677, 2682, 2684 and 2689.
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